INFORMATION

Know your house
LOG BUILDINGS

Log building in Heidalen. Photograph: M. Boro © Riksantikvaren

The Directorate for Cultural Heritage is the adviser to the Ministry of Climate and Environment on the development of the national cultural heritage policy. The Directorate for Cultural Heritage is also responsible for ensuring the implementation of the national cultural heritage policy and in this context is responsible for the work of the county councils and the Sami Parliament with cultural heritage, cultural environments and landscapes.

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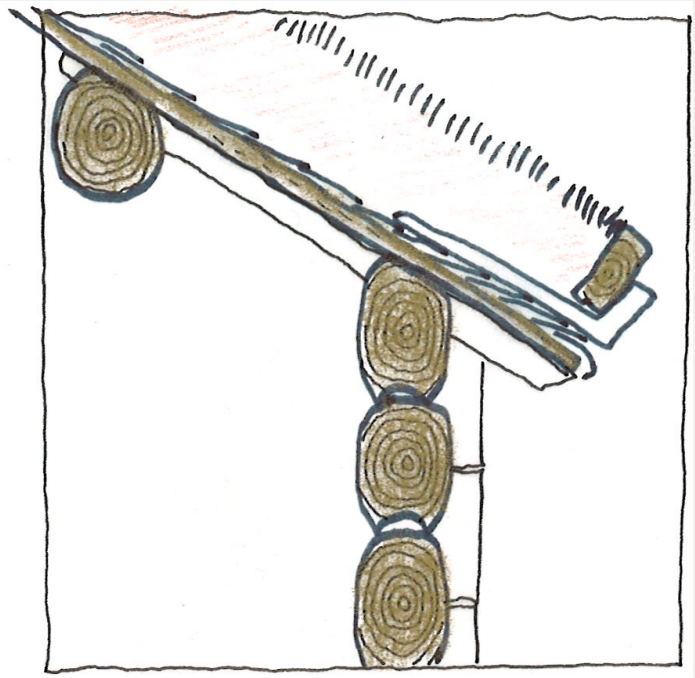
HISTORY

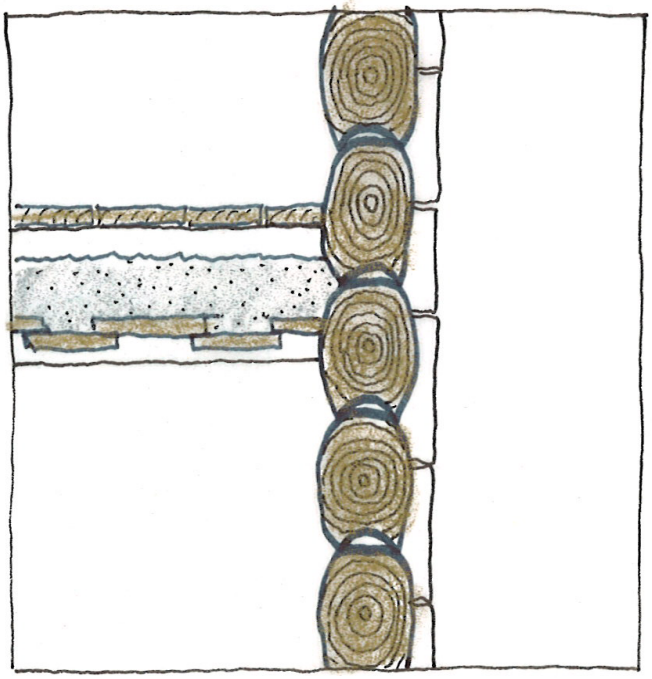
Log construction was the main construction method for houses in Norway from the Middle Ages until the 1900s. Almost every type of building was constructed using logs, from churches and houses to cow byres, hay barns and other agricultural buildings. The technique was used both in towns and in the country. In inland valleys you will find beautiful preserved log buildings with the log walls clearly visible.

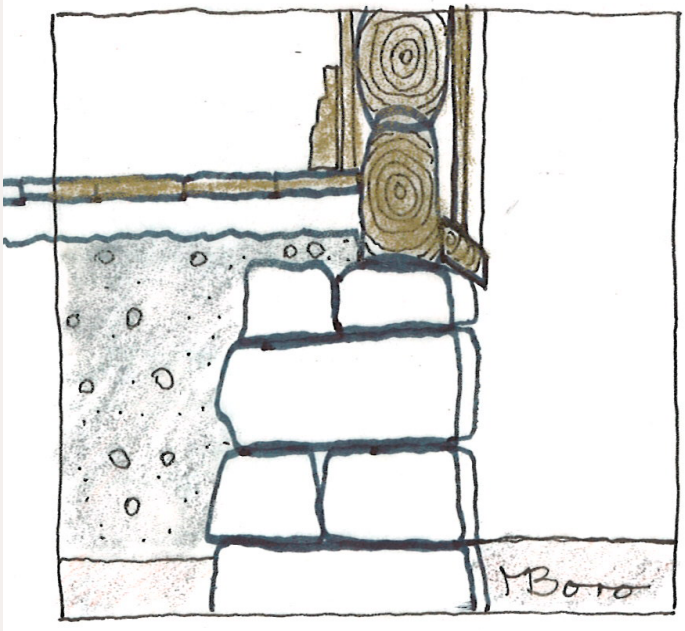
In rural communities in flatland areas of Norway, along the coast and in our "wooden towns", the majority of old wooden buildings are constructed of logs. In towns, fear of fire led to requirements to build in brick and stone. Yet even within areas where building in brick and stone was compulsory, log buildings were still constructed. They were often given an external render which made them look like they were built of stone and this also gave better protection from fire.

Log construction sets great demands on the carpenter. In the Middle Ages, log construction developed into a highly advanced technique. After the 1700s it became common to panel log buildings in the towns and in the coastal districts, and eventually in the flatland communities. This meant that the requirements for log walls were no longer as stringent.

The design of log buildings has changed over time. The design of the log heads and the corners (tenons) are important when establishing the date of a building. Engineered log buildings became common in the period from about 1885 to 1920. Logs were often important stylistic elements reflecting the "dragon style" and the Norwegian National Romantic movement. Nowadays log buildings are mostly built for recreational use, such as holiday cabins.







CONSTRUCTION

Log buildings were common over a long period of time and the construction methods used for the foundations, floors, roof construction and architectural expression thus vary considerably. Information about the different methods can be found in specialist literature which shows the typical construction methods used in different eras.

The length of the log walls was limited by the length of the timber but buildings of a considerable size were erected such as the long "trønderlån" farmhouses of Trøndelag. The internal dividing walls are of major significance in the construction of these large houses. Large buildings may be composed of a number of separate log units or may be a cohesive log construction where the beams are jointed. A number of log buildings have log walls up to the top of the ground floor only, with a half-timbered structure above.

Foundations/plinths

The methods used for building foundations for log building vary and to a large extent follow the development of foundation construction techniques over time. Many older log buildings have a simple foundation using large flat stones which bear the weight of the horizontal sill timbers. One common foundation technique was also to lay stone foundations beneath all the corners– a form of "point foundation" – using large stones often sunk below frost-free depth. The space in between was filled using smaller stones (not sunk to frost-free level) so that it looks like a ring wall.

From the 1800s it became common to use ring walls as foundations, but the methods described above were still used. The construction of the ring wall has changed over time. In its simplest form the ring wall may be a ditch filled with stones with a dry stone wall above. One-sided walls are common (supporting walls).

The walls are stacked up with a "masonry" outer side and rely on backfill for support. However, the wall can also be a coffin wall with two separate stone walls with stone or earth in between. The wall can also be strengthened using lime mortar as a binder. In larger houses the stones are often quarried or evenly-fractured stones so that the load is distributed evenly. More recent log houses have modern foundations.

Drainage was not common in days gone by but ditches were dug and the terrain was worked to ensure that surface water drained away from the building.

Outer walls and load-bearing walls

Log construction comprises using a technique where a section of the upper log is cut out so that it fits into the curve of the lower log and is jointed (notched) at the corners. The construction must be as tight as possible. Traditionally a special type of moss Hylocomium splendens (stair-step moss) was

used between the logs as filling. In order to prevent the logs from twisting or sliding out, concealed wooden pins are used. The wooden pins are driven down into holes in the log above and below at a distance of about 3 metres and never directly above each other. The wooden pins bind the logs together and act to shore up the wall. In some cases, vertical turnbuckles are used for shoring up. Special planks were used to shore up door openings, while concealed wooden pins were often used on windows.

In order for the log construction to work well it is important for there to be good interplay between the walls and within the walls. Hence continuous sill timbers beneath the doors and continuous timbers above windows and doors are essential. Openings near exterior corners are rare as they reduce the strength/rigidity of the structure.

Many log buildings have internal and/or external panels. The back of the panel is usually sealed to reduce draughts. Newspaper has been used for draught proofing and insulation indoors for decades. Many walls are also sealed with lime mortar or clay. Rendered facades on timber constructions made them look like houses built of stone, which were considered to be "grander". You will often see log wall surfaces with big indentations. These were made to enable the render to adhere better. Many interior log walls have been wallpapered. The underlay for wallpaper may be render or plates/panels.

Floors

The floors consist of wooden beams, an insulation space, floorboards and usually a ceiling below the beams. The centre distance was previously bigger (0.8 – 1.0 m) that the current standard. The beams are often insulated with clay, wood chippings or coke in the space between the beams. In some buildings, the boards from the insulation space and the beams form the ceiling of the room below, but the use of panels or other surfaces is also common below the beams. The beams above cellars/crawl spaces normally rest on the sleeper wall, rather than in the log walls, or they are placed directly on the ground. The beams in a log building may be part of the roof structure in raftered ceilings. Log building beams often have an important function in tying the walls together and taking up the forces from the roof construction so that the walls are not pushed out by side forces.

Roof construction

The roof construction of log buildings can be done in a number of ways. Standard construction methods are a purlin roof, either with apex purlins alone or with several purlins, a combination of a purlin roof and raftered ceiling, and various forms of raftered ceiling constructions often with struts, tie-beams or trusses with horizontal beams that tie the structure together. The purlin roof methods distribute most of the weight to the gables and the internal cross-walls, while raftered ceilings and trusses transfer most of the weight from the roof to the transverse walls and any internal transverse load-bearing walls.

Raftered ceilings in houses with no internal transverse walls must have a method for tying the outer long walls together to avoid the logs from slipping out. The cornice method will depend on the type of roof construction. The weight of the roof helps to press the logs together and ensures good compactness. It is important to use good materials on the roof. Turf, slate, wood and tiles are standard roofing materials.

Nowadays the majority of new log buildings are holiday cabins. Log cabins are manufactured in large industrial buildings and brought on site and erected quickly using modern technology. Here you can see the ridgepole being installed. Photograph: Tor Henning Evensen

Panelled log building in the urban environment of Bakklandet in Trondheim. Photograph: M. Boro © Riksantikvaren

Trønderlag farmhouses, known as trønderlåne are very long and narrow. They are normally made up of several log cores side by side. Photograph: M. Boro © Riksantikvaren

WATCH OUT FOR

Constructive cohesion

Log construction depends on the various elements working well together. In a large number of buildings, new openings have been made in the log core over the years. Where these are large or have been poorly executed or are in the wrong place from a structural perspective, these can be critical for the building. It is vital that new openings are made in a way that maintains the structural integrity and cohesion of the walls. Typical examples of damage are:

• New openings close to exterior corners These lead to the buttressing strength of the corner being reduced and in some cases the wall can slide out.
• Cutting sills so that the logs slide out
• New openings without ensuring that buttressing is in place.

Moisture

Wooden structures are subject to rot where there are high levels of moisture over time. Hence it is important not to do anything that leads to moisture collecting in the woodwork. Log walls without external panels are highly exposed to wind and weather, but because the logs are so big, decomposition is slow. They do not have a replaceable skin in the way that panelled buildings do. At the same time the logs have a great ability to dry out when the surrounding conditions allow for this. The majority of damage to buildings is linked to water.

Examples of commonly-occurring damage are:

• Water collecting in the structure because recent painting is too dense. It is not possible to "seal" the wall so that moisture cannot penetrate, so it is vital that the wall is open to diffusion so that the moisture can dry out.
• Raising the level of the ground and the drop to the house so that moisture levels increase. Raising the ground level also means that it becomes more difficult to ventilate the cellar.
• Lack of water channels and gutters quickly gives rise to moisture problems in buildings. If the damage is not repaired this can lead to major damage to adjoining building elements and expensive repairs at a later point in time.

Our modern use of building can create major problems – wash basins have been replaced by showers and indoor temperatures are much higher than before. Our demands for comfort mean that we want buildings that are warmer and draught-proof. These conditions lead to less ventilation in rooms and buildings, major temperature differences both inside and out, increased internal air humidity and greater danger of water leakage due to damaged or missing ventilation fittings. It is thus more important than ever before to use the right materials and methods in order to prevent damage from occurring.

This building, which looks like an ordinary stone building has a timber core on the ground floor. The log wall is hidden behind a rendered facade. Inside the entrance area the wall has been reinforced with slanting hazel wood twigs. On the left is the "peephole" where you can glimpse the log wall on the inside. Oslo. Photograph: M. Boro © Riksantikvaren

Insulation and draught proofing

Loft walls provide relatively good insulation, but draught-proofing is often a challenge. Internal insulation will alter the balance between temperature and humidity in the original part of the construction, and can be critical for the materials with regard to moisture collection and rot. For further information please see the guidance on energy-saving measures.

Panelled log building in Lærdal. Photograph: M. Boro © Riksantikvaren

Ventilation

Older buildings often have natural convection ventilation. Hot air rises and fresh air is drawn in through gaps and air vents. Wood fires and air channels help to create a vacuum. Airing a building by opening windows in the summer is a good, simple solution. Natural convection ventilation provides ventilation without the need for additional energy consumption from fans and heat exchangers and the lifetime of the equipment needed is identical to the lifetime of the building. Increased humidity increases the need for ventilation. When renovated, buildings are made draught-proof and infiltration decreases. This leads to many older buildings ending up with almost no ventilation for large parts of the day. Nowadays ventilation fans have been installed in kitchens and bathrooms in many houses. This is a good solution but you must ensure that there is enough fresh air, i.e. vents or gaps so that fresh air can get in. A certain amount of vacuum in a house is good so that the moist internal air is not forced out into the walls but instead is vented outside.

Foundations

Many old houses have poor foundations and have suffered damage to their foundations due to digging out the ground close to the building. This, together with poor drainage, is an issue that often requires improvement. When working on land close to the house it is

ADVANTAGES OF LOG HOUSES

Constructive cohesiveness
The interplay between the different elements in a log construction gives a strong, flexible structure with a great ability to adapt in spite of faults and damage to the foundations.

Materials that cause minimal damage to health and the environment
Log buildings traditionally consist of natural materials without components that can cause damage to health and the environment.

Removable/reusable
Log constructions are removable in that the parts of the main structure can be taken apart and put together again without being damaged. This means that they are reusable and can be moved. There is a long tradition of moving entire buildings or reusing parts of an old house in a new one. This also makes it possible to repair damage by replacing the damaged elements without having to remove large amounts of undamaged material.

Cold, airy lofts
Many log constructions have cold, airy lofts, traditionally used as drying areas and for storage. This means that moisture in the form of condensation cannot collect, and that the roof construction, including the cornice structure, is kept dry. This also means that the roof is kept cold in winter thus avoiding snow and ice melting and hence reducing damage to gutters and downpipes.

Natural ventilation
Natural ventilation is a good method of ventilation requiring little in the way of resources when the right conditions are in place.

Windows
Windows are particularly exposed parts of a building. Old windows are often made of good materials and are of a high standard of craftsmanship.

Cultural history values
There are major cultural history values attached to many log buildings. Many of them are important elements and fixed points in our cultural and architectural history and are important elements in valuable cultural environments.

important not to disturb the foundations unnecessarily so that settlement occurs. It is also important not to dig deeper than is necessary to avoid disturbing any raft foundations and ground water levels.
Log buildings without a cellar often have stone/earth infill inside the foundation wall so that the beams lie on earth/sand. This is a risky construction method because moisture can easily collect due to the lack of drainage or the surrounding terrain being raised. Wood can remain damp for long periods of time.

Noise

Sound-proofing to protect against external noise (air-borne sound) has not been a major issue for log buildings. The log construction consists of relatively heavy structures that reduce noise to some extent. As a rule, most noise gets into a building through windows and gaps in the walls. Noise coming through internal walls and floors (footsteps and air-borne noise) has become a much greater problem, particularly in buildings that contain a number of dwellings.

Loft insulation clay dampens the sound between floors effectively but where there are a number of cohesive wooden structures and gaps this can create footstep problems. In general it can be said that coarser materials and good craftsmanship result in less noise between the different spaces.

Log house under restoration. The panel has been taken down temporarily. Note that the wooden apex is not made of logs. This is a commonly-used method.
Photograph: M. Boro © Riksantikvaren

FURTHER READING

The Directorate for Cultural Heritage's information leaflets
Trevirke: Råteskader i bygninger (Timber: damage caused by rot in buildings. In Norwegian)
Vedlikehold av tømmervegger (Maintaining timber walls. In Norwegian)
Vedlikehold av panel (Maintaining panels. In Norwegian)
Vedlikehold av vinduer (Maintaining windows. In Norwegian)
Vedlikehold av ytterdører (Maintaining external doors. In Norwegian)
Utvendig maling: De viktigste egenskapene (Exterior paintwork: the most important characteristics. In Norwegian)
Energieffektivisering (Energy efficiency measures. In Norwegian)
The Society for the Preservation of Norwegian Ancient Monuments:
Gode råd om vinduer i eldre hus (Good advice about windows in old houses. In Norwegian)
Gode råd om mur og puss (Good advice on stone walls and render. In Norwegian)
Gode råd om yttervegger i eldre trehus (Good advice on exterior walls in old wooden houses. In Norwegian)
The Cultural Heritage Management Office's information leaflets:
Tilstandsvurdering av bevaringsverdige bygninger (Assessing buildings deemed worthy of preservation. In Norwegian)
Vinduer (Windows. In Norwegian)
Aanensen, Brænne, Drange:
Gamle trehus. Historikk, reparasjon og vedlikehold. (Old wooden houses. History, repair and maintenance. In Norwegian) ISBN139788200053491
Jon Bojer Godal:
Tekking og kledning med emne frå skog og mark. Frå den eldre materialforståinga (Roofing and cladding using materials from fields and forests, based on traditional understanding of materials. In Norwegian)ISBN 9788232100392
Anders Frøstrup:
Rehabilitering. Konstruksjoner i tre. (Renovation. Wooden structures. In Norwegian) ISBN 82-00-40934-1