Contents

1. Preface.

This Standard has been produced by the Norwegian Log Home Builders Association, in cooperation with the Norwegian Institute for Wood Technology. The standard is primarily a result of expertise and knowledge contributed by association members and other log building specialists. Taking into consideration local variations and practice between companies, the standard aspires to be flexible enough to accommodate several solutions. The standard can be used for new construction and restoration work. On listed structures, expect additional demands.

Therefore, the standard contains general requirements and material requirements which must be accepted. The recommended solutions and details have a lesser priority and can be different when documented alternatives fulfil general requirements.

2. Scope

This standard lays out functional requirements for a log built structure, as well as material requirements.
The standard is not comprehensive for all parts of a building and must therefore be used together with a number of other recognized standards. Design fact-sheets from the Institute for Construction Research are recommended, especially: *523.291 Log Built Walls*
The standard can be used in connection with contracts and quality control. Technical issues are covered but not esthetical.

3. Reference Material

NS 3420-0	Constructional Guidelines
NS 3470-1: 1990	Draft Guidelines, Calculation and Construction
RT 82-10415	Log Construction Planning Elements (Finnish Document)

Recommended Fact-Sheets from The Institute for Construction Research

523.291 Log Built Walls
525.814 Joists
525.824 Perlins

4.Terminology

Key-Piece	Vertical piece of lumber inserted into log-ends at door, window and other openings to stabilize walls. Three types, T-form, where width is comparable to wall width, Blind key-piece, where a square piece of stock is inserted into log centre and massive lumber piece which the log end is keyed into.
Dowel	Loose dowel connecting two wall logs
Hand-Crafting	Log building where the notch is formed by hand, however the log may be formed in various ways: • With normal taper and curve • straight taper • hewn on four sides Local traditions flourish and stylise finished products
Saddles	Hewn or planed scarf on log sides in notch region.
Notch	Marrying of logs at wall corners
Notch Neck	Remaining wood in notch-centre when all notch work is completed.
Log End	Part of log protruding from notch outside of wall
Kerfing	Groove along log to minimize checking.
Machine Log Building	Industrialized production where hand labour is minimal
Horizontal Channel	Cavity along underside of logs in a log wall
Scribe Line	Outer edges of channel cavity where wall logs are in contact
Top Plate Log	Top log in the side wall of a building
Bottom Plate Log	Bottom log in the side wall of a building
Top Plate Rafter	Rafter in traditional designed log housing fastened to side purlin and extending out beyond top plate log. Carries the roof extension
Wall Bracing	Vertical planks mounted on both sides of log walls with steel through-bolts.
Settling	Result of shrinkage and compression
Purlin	Log beam(s) used to transfer roof weight to gable walls

General Requirements

5.1 Moisture and settling considerations.

Allowable log-moisture content
Average moisture content must not exceed 20% during structure production. A maximum of 10% of logs may have a higher %, however no logs may exceed 25%. This requirement is also for purlin logs.
Moisture must be checked using a special device which is inserted 30mm into the surface of the log.

Settling.
All constructional details and fittings must be done in such a way that they allow for 3% settling.

The Roof
A heavy roof is mandatory, minimum 100 kg/m2. The sod should be on the roof as early as possible in the on-site building process.

When securing the roof, attention must be paid to the fact that the roof angle changes. Table 1 shows details of rafter-movement for a selected number of house widths and roof-angles.

Table 1 rafter-displacement in mm at 3% settling of log gables

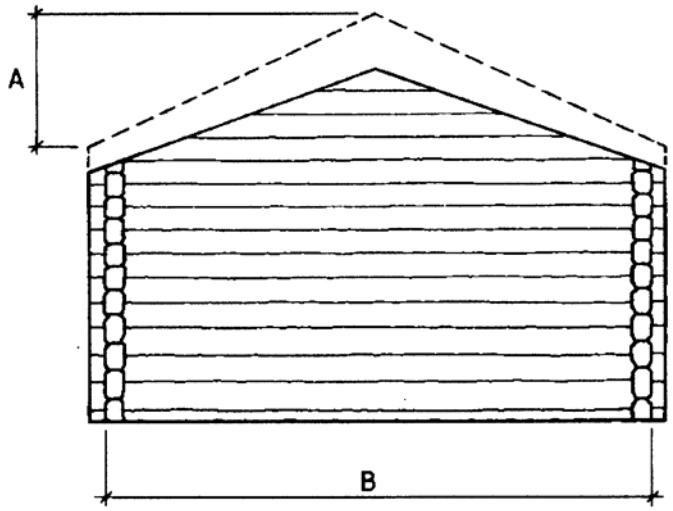
House Width (mm)	Relationship between gable height and house width		
	1:3	**1:4**	**1:5**
3000	16	10	7
4000	22	13	9
5000	27	17	11
6000	33	20	13
7000	38	23	15
8000	44	27	18

Given 3% settling, the distance between gable peak and top plate log changes in this manner:

Change:

$$\sqrt{(A^2+B^2)}-\sqrt{(A\times 0{,}97)^2+B^2}$$

Where:
B: ½ x house-width
A: Height from top of top plate log to gable peak.



Figur 1. Takvinkelen endrer seg når bygget synker (fra Byggdetaljer 523.291 Laftede vegger, fig. 314, © Norges byggforskningsinstitutt)

5.2 Stability and Load Bearing

Roof, rafters and logs over openings must be calculated in accordance with NS 3740 Examples are to be found in technical fact-sheets: 525.824 and 525.814 from the Institute for Construction Research (Byggforsk)
The various stress factors in a log wall are such that NS 3470 is not suitable for log wall design details. Table 2 is part of the Finnish Standard RT.82-10415 and gives maximums for wall-lengths with round and side-cut logs. The standard also gives minimum widths for the transposed elements which could be log walls, in combination with log-bracing (strekkfisker)
Table 2. With a wall height of 2.5 metres. Live loads are included in figures.

Log Profile	Capacity q (kN/ m) for wall spans between transposed elements					
Mm	3m	4m	5m	6m	7m	8m
R70	7	4	-	-	-	-
R95	19	10	7	6	4	-
R120	41	23	16	12	8	6
R145	76	41	29	21	14	10
R175	134	72	52	36	24	15
R200	202	109	78	54	36	23
Ø130	27	16	10	7	6	4
Ø 150	43	26	16	12	10	6
Ø 170	65	39	24	18	14	10
Ø 190	93	55	34	26	20	14
Ø 210	129	75	47	37	27	19
Ø 230	172	100	63	49	36	25

5.3 Climatic Considerations

Log buildings should not be constructed or placed in locations where they would be exposed to excessive driving rain. Acceptable amounts of driving rain should be considered in relation to chosen wall construction and maintenance.

5.4 Log Collapse and Cracks

All log-work details should be carried out in such a way that it minimizes the risk of log-collapse and crack-formation.

5.5Tolerances

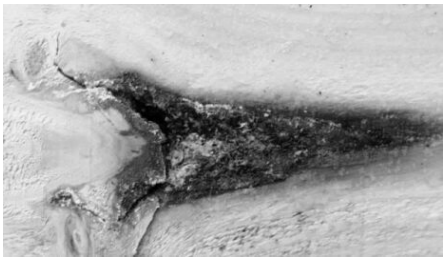
Acceptable vertical tolerance: 1% for machine produced and 1.5 % for hand-crafted structures. Measured over minimum 2 metres

6. Materials

Both spruce (picea abies) and pine (pinus sylvestris) are acceptable. When other timber is used, it must be proven to be as durable as pine or spruce. Glulam is acceptable. Wood type should feature in any contract.

Material quality
Quality logs which are strong, stable and durable must be chosen. Any deviation must be noted in the contract.

- Spiral Grain: maximum 1:10 Valid for right-hand grain. Left-hand spiral grain allowable at max: 1.20
- Spike Knot, max 1 pr 1.5m size: max ø 2cm (see illustration)
- Unsound Knot: max 1 pr 1.5m. max ø 2cm The rot must be contained in the knot
- Reaction Wood: (3cm away from core) Acceptable in up to 5 year rings in half the log circumference
- Weathering: not allowed internally, only small amounts externally
- Average year-ring: 4mm in the butt (2cm from the core out) Largest allowable otherwise: 6mm
- Biological damage which reduces durability is not allowed. Blue stain is acceptable in small quantities
- Holes from tree borers not allowed.



Spike Knot

7. Recommended Details and Requirements

It is for construction of ordinary housing that the details and requirements have been formulated. Unusual structures may demand other solutions to harmonize with section 6, general requirements. Deviation from recommended details and requirements may be permissible when chosen solutions satisfy section 6 In cases where the standard is part of a contract, deviation should be stipulated.

7.1 Construction Details

- The horizontal channel must be minimum 45% of the log width. Where round logs are used, the log diameter deciding channel-width minimum, shall be the upper or lower log in a course of logs, which has the smallest diameter.

- To prevent water penetration between logs, the lower log top in a course should be minimum 10% of the scribe width, *higher than the scribe-line.* The underside of wall logs should have a concave shape finishing at the scribe-line in a sharp edge. The horizontal channel should be insulated and wind-proofed with suitable material
  Insulation material should not be visible outside the scribe-line or notch

- The scribe-line and notch should produce a tight fit at production place/time.

- With machined log buildings, a variety of tongue and groove log-channel solutions are permissible.

Saddles
After on-site log shell construction, saddles should show a tight fit. Saddles on upper and lower logs in a notch, should meet at clearly defined points.

Log Neck
For notch strength the neck of the notch must be as large as possible. Suitable compression space should be a feature of the notch.

Esthetical considerations
Log surface finish should be included in the contract. Hewn or smooth “texture” ought to be specified.

7.2 Joining Logs

Moisture content in logs to be joined must be even and not deviate by more than 4% Logs should be primarily joined in the notch. In such cases, to prevent slipping or horizontal movement, joining-logs must be secured to each other in a suitable manner.

A variety of log Joins outside the notch are permissible. Here it is important that the chosen solution results in a strong, air-tight connection..

7.3 Door and Window Mounting

The key-piece should be minimum 3% shorter than the height of the window opening. Follow the same rule with doors. A suitable vapour-barrier and insulation material should be used around doors and windows.

Key pieces
When wall openings are greater than 1metre, the t-profile key piece should be used. The key-way should be 1/3rd of wall thickness or min 45x45mm. Blind key-pieces are required to be minimum 45x45mm and may only be applied when wall openings are less than 1 metre or with a wall length of max I metre.

7.4 Internal Walls and Fittings

It is not permitted to use load bearing log walls and load bearing stick frame walls on the same floor in a house. A shrinkage gap of 3% over stick-frame walls must be allowed. This rule must also be applied to staircases.

7.5 The Roof

Purlins must be notched/secured in such a way that they lock into place.
Joining purlins must only be done on load-bearing log walls.

For purlin span calculation see 6.2

With transposed roof details or dormers, the chosen technical solution should allow for settling.

Securing of roofs to walls and purlins
The producer of the structure decides the practical methods. Bearing in mind roof-angle change, the chosen method must not result in damage due to settling.
The chosen proportions should not result in joists displacing more than 10mm due to settling. (Unless allowed for by the use of sliding brackets)

7.6 Wall Bracing

Use of dowels
Wall lengths of over 5 metres should be braced with dowels. Dowel holes should be 5% longer than dowels. The distance between dowels can be approx 2.5 metres. Where logs are joined by notches, the join must always be secured with dowels at both ends of the said logs near the

notch. Log openings without notches or other bracing in their vicinity must be secured with a dowel in each log near the opening.

Additional bracing of long and high walls
Longest allowable wall-length without bracing in the form of a notch or other bracing is 7 metres or 18m2 wall area. When glulam is used, 10 metres is the norm or 30m2.

7.7 Kerfing

In an effort to reduce checking in undesirable places, kerfing of logs is acceptable. Roof purlins can also be kerfed.

8. Recommended Litterature

NS 3490	Projecting Guidelines. Dependability Requirements
NS 3491	Projecting Guidelines. Load Bearing Part 1 Dead loads and Live Loads Part 2 Snow Loads Part 3 Wind Pressure
Construction Management 723.304	Old Log Walls, Methods and Materials
ETAG 012	Edition June 2002; Guideline for European Technical Approval of Log Building Kits
Godal, Jon Boyer	Load Bearing Systems in Old Norwegian Houses. TI Publishers, Oslo, 1994
Godal Jon Boyer	Suitable lumber/logs for Log Building and Timber Frame. Landbruksforlaget, Oslo, 1996
Hauge, Tore	Litlemannen og Skoftungen.TI Publishers, Oslo 1994.
Strømshaug, Kristian	Log Building. Landbruksforlaget. Oslo 1997