# EFFECT OF KERFING ON CRACK FORMATION IN SCOTS PINE LOG HOUSE TIMBER

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## ABSTRACT

In Norway log buildings are normally produced from logs canted on two sides. The canted faces are prone to crack formation during drying. This can cause some disadvantages, e.g. the cracks can trap water from rainfall, because the canted faces form the wall surfaces in the log buildings. The objective of the reported study was to apply saw kerfs on the upper side of the cants prior to drying to reduce crack formation in the canted faces. The material consisted of 150 mm wide cants produced from Scots pine (*Pinus sylvestris*) logs with a mean top-end diameter under bark of 23 cm. Immediately after canting the cants were divided into four groups: A Chain saw kerf to pith, B Circular saw kerf (9 cm deep), C Circular saw kerf (4.5 cm deep), D Untreated control. The timber was air dried and stored under roof for 4 years. Widths of cracks in the side faces were measured. The results showed that mean crack width was reduced by 60 % by applying chain saw kerf (treatment A). The two other treatments had limited effect on crack formation in the side faces.

Key words: Log building timber, kerfing, crack formation, Scots pine

## INTRODUCTION

Traditional log buildings are usually made of large dimensioned boxed pith timber. In Norway log buildings are normally produced from logs canted on two sides. The canted faces are prone to crack formation during drying. Such localization of the cracks can reduce the quality of wooden structures in several ways. They can reduce the duration of the work are exposed to outdoor climate as it tends to accumulate moisture in the cracks, which causes the environment of decay fungi is favored. The cracks will also result in increased heat loss through walls and thus lead to increased energy consumption in the building's use phase. In addition, cracks appear aesthetically displeasing.

Cracks are caused by mechanical stresses during drying. Drying stresses occur because of the differential shrinkage between the outer part of a log and the interior part. Early in drying, the fibres in the surface dry first and begin to shrink. However, the core has not yet begun to dry and shrink; consequently, the core prevents the outer part from shrinking fully. Thus, the outer part goes into tension and the core into compression. On

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large dimensions the mechanical stresses exceeds the elastic limit of the wood matrix and cracks occur. In addition to the moisture gradient during drying stresses are formed due to the anisotropic shrinkage of wood.

Inducing artificial cracks can be a tool to control the location of cracks to positions where they are less harmful. One possible solution can be to initiate cracks by driving wedges into log building timber (Vreim 1975, Steen 1996, Clementz and Flatland 2008). However, this is a laborious method, and it appears not to have been recurrently practiced.

The objective of the reported study was to evaluate different types of saw kerfs as a rapid method to reduce crack formation during drying of log building timber.

## MATERIAL AND METHODS

In April 2005, 39 pine logs were canted on two sides and debarked to produce 150 mm thick log building timber. All logs had a length of 5 m. The logs were purchased from a harvest of a 125 years old Scots pine (*Pinus sylvestris*) stand in Ringerike municipality performed by Viken Skog BA.

Average top-end diameter under bark was 23 cm, varying from 21 cm to 26 cm (Table 1).

**Table 1.** Number of logs and top-end diameter for each treatment

| **Treatment** | **No. of logs** | **Top-end diameter (cm)** | | | |
|---|---|---|---|---|---|
| | N | Mean | St. dev. | Min | Max |
| A: chain saw to pit | 10 (5 butt log/5 second log) | 22,5 | 1,2 | 21 | 24,5 |
| B: circular saw 9 cm | 10 (5 butt log/5 second log) | 22,4 | 1,1 | 20,5 | 23,5 |
| C: circular saw 4,5 cm | 10 (5 butt log/5 second log) | 22,3 | 1,2 | 20,5 | 23,5 |
| D: control | 9 (4 butt log/5 second log) | 22,7 | 1,2 | 21,5 | 25,5 |

The treatments A, B and C (Table 1) were carried out immediately after canting and debarking. One longitudinal saw kerf was produced on the upper side, referring to the position in a wall, of the logs (Fig. 1). The saw kerfs started and ended 50 cm from the log ends. Kerf width for treatment A was about 10 mm, while kerf width for treatments B and C was 3 mm.

The log house timber was air dried and stored under roof until late summer of 2009. Then the timber was stored in a room with 20 °C and 65% RH for about two months before registration of cracks.

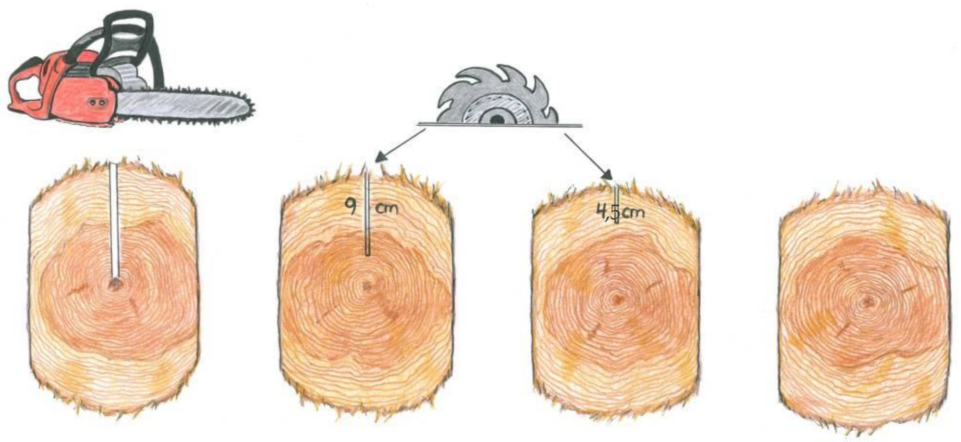


**Fig. 1.** Illustration of the treatments (Illustration: Sigrun Kolstad).

Cracks were recorded on the side faces of the cants with an electronic caliper (Mitotoyo CD-20CX) (Fig. 2). The width of the crack across the length direction was measured at the surface. Measurements were performed 50 cm from each end, and every 50 cm along the cant. Average crack width of a cant was calculated as the average of all the crack width measurements made on both side faces (Figure 2).

Samples for calculation of wood moisture content were extracted 2.5 m from the ends of the cants. The samples were taken from three radial zones: 0-3cm, 3-6 cm and 6-9 cm from cambium at the opposite side of the kerf. The weight of the samples was measured with a Mettler Toledo HB43-S Halogen drying balance

Comparisons of different treatments were carried out by one-way analysis of variance (ANOVA). Tukey-Kramer analysis was used for multiple testing. Effects with a probability of type 1 error smaller than 0.05 were considered significant. The statistical analyses were performed using JMP 8.0 (SAS Institute).

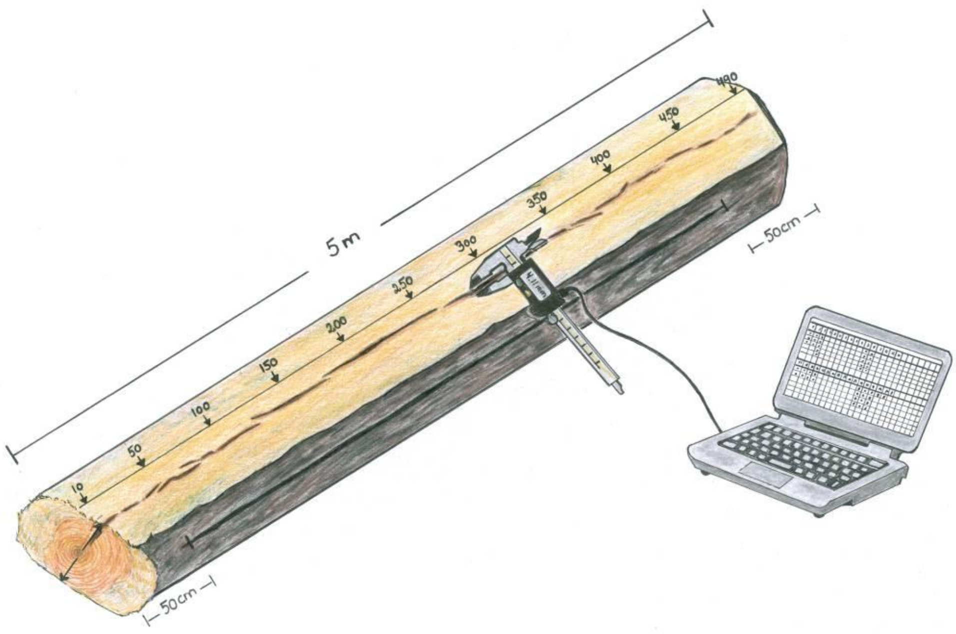


**Fig. 2.** Illustration of crack detection (Illustration: Sigrun Kolstad).

## RESULTS AND DISCUSSION

The prevailing crack pattern was one continuous crack along each side face of the cants.

The results show that the average crack width in the side faces was narrower for all three treatments (A, B and C) compared with the control (D). The effect was not significant for the two treatments with the use of circular saw (B and C). There was also little difference between the circular saw kerf with depth of 4.5 cm and 9 cm. Average crack width was significantly lower in the logs with the chainsaw kerf to pit (treatment A). The average crack width for these cants was 58 % narrower than in the control cants.

**Table 2.** Crack width in the side faces of log house timber.

| **Treatment** | **N** | **Mean** (mm) | **St. dev.*** (mm) | **Min*** (mm) | **Maks*** (mm) |
|---|---|---|---|---|---|
| A | 10 | 1.5 | 0.81 | 0 | 4.3 |
| B | 10 | 2.7 | 1.78 | 0.3 | 8.0 |
| C | 10 | 2.9 | 1.82 | 0 | 9.7 |
| D | 9 | 3.6 | 1.96 | 0 | 7.5 |

* Standard deviation, min and max values are based on all measurements within each treatment.

Average crack width was not significantly different in cants from the butt or second logs. This is probably because the logs had about the same top-end diameter, regardless of what part of the trunk they were cut from.

Wood moisture content in different radial zones of the cants is shown in Table 3. There were no significant differences or trends in moisture content between treatments, but the moisture content rose slightly from the surface towards the pit of the cants.

**Table 3.** Moisture distribution in the log house timber

| Depth from cambium (cm) | N | Moisture (%) | Standard deviation (%) |
|---|---|---|---|
| 0-3 | 18 | 13,8 | 0,9 |
| 3-6 | 18 | 15,4 | 1,3 |
| 6-9 | 18 | 16,1 | 1,8 |

The Norwegian industry standard for log buildings (Kvalitetskontrollen Norsk Laft 2009) requires that the average moisture content of log building timber is 20 % or lower. The range of individual values shall be within + 3 %/ - 5%. Moisture content should be measured with electrical resistance meter with an insertion depth of 30 mm.

Finstad and Sandland (2009) measured wood moisture content in the walls of two log buildings in Eastern Norway in February, June and October. One was a heated building, and the other a storage house without heating. The measurements were made in 1 cm and 5 cm depth from the inside and outside of the walls. In the heated building, the average wood moisture content at the three times varied between 8.4 % and 11.1 % for measurements made from inside and between 10.9% and 12.9% for the measurements done from the outside. In the storage house, the average wood moisture varied between 13.2% and 16.5% for the measurements from the inside of the wall and between 14.4% and 19.0% from outside.

In the present study the moisture content was slightly higher than that Finstad and Sandland (2009) found in the walls of a heated log building. Although it cannot be excluded that the cracks could develop something more if the timber in this study were used for a heated building there is no reason to assume that this will affect the relative efficacy of different treatments, since there was very little variation in wood moisture treatments.

## CONCLUSIONS

The results from this study shows that cutting longitudinal saw kerfs in canted log house timber prior to drying can reduce the cracking in the side faces substantially. The largest crack reduction was achieved by using chainsaw with saw cuts to the pit. In these cants the average crack width was almost 60 % narrower than in the untreated control cants. Using a circular saw with a cutting depth of 9 cm or 4.5 cm had a limited effect on the average crack width in the side faces.

Since kerfing with a chainsaw can be performed fast, this is a method that may be appropriate to use if one wants to limit the crack formation in log house timber during the drying process.

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