

Techniques of Cleaving Wood with an Axe and Mallet- Deconstructing Present Craft Knowledge, in order to Reconstruct Historic

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In 2001, the corner timbered church of Södra Råda burnt to the ground. The Swedish National Heritage Board immediately proclaimed that the church should be reconstructed 'as a pedagogical example to enhance craft practice and historical knowledge of medieval churches'. In 2007, the reconstruction of the church began. The loss of a national treasure and the findings made in extant churches during the reconstruction work has been one of the reasons for several ongoing diocese projects that mainly focus on an inventory of medieval roof trusses but also on other historic carpentry constructions details. (Hallgren et al 2015, Gullbrandsson 2015, Melin 2016, Eriksson 2016).

Recent analysis of cleaved wood in historic constructions has enhanced our knowledge about the historic making and use of cleaved timber that contests previous assumptions. The results will be shared in this paper. The complexity of possible used methods that commonly leave few or no traces will be shown in the three cases that are presented in this paper: the cleaving of rafters and boards for the Södra Råda reconstruction, the cleaving of boards for the medieval tithe barn in Ingatorp and the experiment of cleaving eight 13 metres long rafters out of one felled timber in order to understand the original cleaving methods used at Hardemo church (Almevik & Melin 2015 & 2016, Melin 2014, Eriksson 2016).

The method of investigation will also be discussed. Professional carpenters also are craft researchers that organize questions and evaluate results by comparing the results with known historic samples. Thus, craft research of today's cleaving is a continuing process that has evolved and refined over many seasons. By deconstructing contemporary craft knowledge and by putting aside one's personal opinion of good craftsmanship the aim is to understand an historic craft from a viewpoint close to the historical practitioner's methods and not from a modern contemporary view.

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Fig 1. Left; "Spårning" during the second cleaving of a boxed timber into boards. Photo Daniel Eriksson. Right; The second cleaving is almost done. Before the boards are separated so much waste material is hewn off as possible. Photo Karl-Magnus Melin.

This article can be seen as a follow-up to two earlier articles concerning the experiments of board cleaving for the reconstruction of Södra Råda corner timbered church and the restoration of Ingatorp Tithe Barn.[1] In the first article I and Gunnar Almevik gave a background about Södra Råda church built around 1310 which burnt down in 2001. We also described the reconstruction work from a theoretical point of view where we tried to fit in our reconstruction methods with current theoretical concepts. We made reviews of earlier experiments and tried to compare the method used with theoretical hypotheses. A step by step description of board cleaving experiments was also included. In the second article, we presented the restoration and in-depth documentation of the corner timbered tithe barn in Ingatorp, dendrochronologically dated to the 1220s. Further important background elements for the present article are new findings in ongoing diocese projects including one example of an unique experiment of cleaving 13 m long rafters in order to understand the techniques used in 1274/75 when the Hardemo church spire was re-erected.[2] In the present paper the focus will be on the reconstructed medieval cleaving methods, the deconstruction of contemporary craft knowledge and an update of new findings in historic manuscripts, in church attics and during our field experiments.

Historical records of cleaving and recent interviews with craftsmen

In the 18th century the authorities in Sweden claimed that the forests in Sweden were declining and overexploited. Papers were written and decrees issued on the topic of economising resource use by saving the forest. Examples of decrees are when the state in 1734 proclaimed that wooden fences should be replaced with fences of stone,[3] and the decree from 1759 that is about restrictions on the building of wooden bell towers.[4] In order to change the customs more or less propaganda was spread proposing Scanian half timbering as a good example of less use of wood than when building corner timbered houses[5] while other writers claiming half timbering to be a bad choice because of extensive use of wood for constructions with short life span.[6] More specific papers dealt with the wood consuming practice of cleaving wood with axe and mallet. In these articles, it was meant that the technique of cleaving was a very bad choice since it only was possible to get two boards out of

one log[7]. Instead it was proposed that the use of pitsaw or water powered sawmills should be used. In the 1920s Nordiska museet, among other institutions, started to take records from tradition bearers concerning, among other subjects, house building and traditional crafts. There are but a few records from tradition bearers in questionnaires regarding methods of cleaving timber collected by the folklore archives. It should be noticed that these records primarily reflect how cleaving was done in the approximate period 1860-1920. But among the descriptions of cleaving, information from two tradition bearers had crucial information in order to understand and reproduce boards and rafters that corresponded to the medieval ones.

The carpenter August Holmberg provided explicit information from Blekinge. He was born in 1860 and reported his memories of traditional building crafts to *Nordiska museet* in the 1930s. In the questionnaire, he claims that it is possible to make eight boards from one log, if the log is large enough. He does not relate the number of boards to the quality or the length of the log. The process of cleaving includes “*spårning*” with an axe and a mallet and the use of wedges of dry beech. I have no English word for “*spårning*” and since it is an elementary operation in controlled cleaving I use the Swedish word. The meaning is: to hit an axe with a mallet into the log as it cuts warped fibres.

In the Sjösås church we[8] have documented tool marks from *spårning* on a roofing board. Usually these marks were cut away in the later steps of the *sprätthuggning* process, see fig 2. *Sprätthuggning* is the word I use to describe the medieval Scandinavian hewing technique where the axe cuts in the direction of the fibres and not against the grain. This technique became more or less obsolete after the black death.



Fig. 2 Traces of *spårning*. The arrows show the direction the axe was driven down plumb. Photo Daniel Eriksson.

Key information was also given by an old craftsman, the carpenter Evert Jönsson.[9] He was born in 1917 and worked as a carpenter all his life. As a boy, he accompanied his father and observed and learned old techniques before they became obsolete. When interviewed about hewing techniques, he described how they used a broad axe to make the logs square. Then he described how the blocked timber was cleft with an axe and wooden wedges. When asked about the quality requirements, he said that his father did not choose the trees, as it was the customers who provided the logs.[10]

Medieval artefacts

The most important source material is the extant boards and rafters that we have investigated in many churches over the years. The extant material is huge, but in most cases the surfaces only show tool marks from the hewing

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and all traces from previous operations are removed. Traces of the most important procedure we call "spårning" is only documented so far on one board. Only occasionally the end tree can be inspected to give a clue if the board/rafter is taken close to the core or further out.

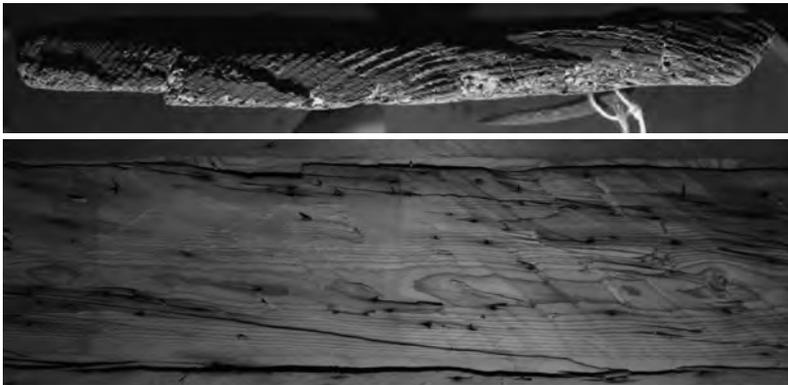


Fig 3. Above; Cleaved board from Hammarö church, SHM 23700:6. Note the almost horizontal growth rings, which strongly indicate that four boards were produced from one timber. Below; Roof board from Tångeråsa church. The board has very warped fibres. It was necessary to use a controlled cleaving technique to make this board. Photos Karl-Magnus Melin and Christina Persson.

The quality and species of wood in the same church can vary, with big knots and very warped fibres to almost knot-free and straight-fibred boards. According to these observations it seems like the craftsmen who built the medieval churches aimed at producing straight boards regardless of whether the natural fibres had to be cut which indicate a controlled cleaving process was used.

The tools are very important also, and in dialogues with blacksmiths axes have been made where the task was to produce copies as exactly as possible. Irregularities and what might seem as deformation were reproduced in order to evaluate a historic tool and not a corrected interpretation based on modern views of good craftsmanship. We have chosen tools after interpretation of tool marks and after a survey in museum tool collections.[11] The axe from Lödöse, (fig. 4), is of a type hitherto found in nine specimens, from Denmark in the south to Lödöse in the north. Two of these axes have been stratigraphically dated to the period 1300–1350. Copy's of the axe are well balanced and works well for *sprätthugning* and also for making of shingles. For *spårning* we use another type of axe with a thin and long blade.



Fig. 4. Axe from Lödöse (Lödöse Museum, inv.no. 27600:443:H:345). Photo Karl-Magnus Melin.

Ongoing investigations in the project Historic carpentry art in the diocese of Lund has gained new insight in hitherto undocumented roof trusses from the 12th century. The oak rafters in at least six of these roofs are split and have a trapeze square section.[12] At first it can seem a bit odd that the small side or the side closest to the core is in all cases also the side closest to heaven. But the most probable reason is because when oak is cleaved it tends to bend. Then if you put the wane side out the roof might look like its decomposing and not as strong as if there is a small convex curve on the roof slope. This finding has a unique parallel in Hardemo roof spire that has been investigated in the context of the project Medieval roof trusses in the diocese of Strängnäs.[13] The rafters in Hardemo are made of pine and the longest are over 13 metres. Unusually for rafters of pine the square sections were quite similar to the trapeze shaped oak rafters but the wane side was not at all hewed.

Medieval accounts of controlled cleaving of timber

I have been looking for medieval accounts of cleaving and one of the most important clues I have is from an illustration made 1111 in a Citeaux manuscript. On the picture two monks are “spårning” a log. Recently I found another illustration, made 1480-90, showing a boxed timber that is undergoing controlled cleaving. The picture was made to illustrate a German fable about a monkey that gets trapped in a log as he tries to do the craftsman’s work but instead pulls out the wedges and get caught.[14] The first illustration is a proof for the historical use of controlled cleaving with axe and mallet. The last illustration confirms that controlled cleaving of boxed timber, as described above, was not an oddity done in early 20th century Scania.



Fig.5 Left, *Moralia in job* https://upload.wikimedia.org/wikipedia/commons/6/6c/Cistercian_monks.jpg (Last consulted 19 january 2017)

Right; Notice the wedge he pulled out can be seen on the ground. *Buch der beispiele*:http://digi.ub.uni-heidelberg.de/diglit/cpg85/0048?sid=08f64c374674d9f1f3e910e98afe46ce&ui_lang=eng (Last consulted 19 january 2017)

Deconstructing craft knowledge

When the discussions started about how to produce cleaved boards me and my colleagues more or less shared common craft knowledge about how to do and the characteristics of a cleaved board. A short description of our knowledge of that time can be summarised as:

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It is essential to choose timber with straight fibres. The craftsmen of the past had extreme abilities to observe signs that revealed the trees fibres, this knowledge was lost and so was the forest that held these fantastic trees they chose. The cleaving of pine starts from the top end. Wedges are driven in with force from the end and the fibres stay intact. Cleaving is done on round logs that get at least partly debarked. If the fibres make the result to look more or less as a cork screw some of it hopefully can be sawed by hewing away material. If everything works out well most of the wood is hewn away as only two boards can be produced from each log. We had also been told that the Citeaux illustration most probably did not show an authentic procedure, because medieval axes are too weak to manage to be hit upon with a mallet. And maybe even worse it is bad craftsmanship, a true carpenter wields the axe!

As our in-depth examination of original boards and rafters went on we had to criticise our knowledge hard. Nothing seemed to make sense. The lyrics, “*Don’t believe it, it’s all a con -Everything you think is wrong!*”, from a Sub Hum Ans song called “*Think for yourself*” seemed like a possibility and the title as a wise advice.[15] I and my colleagues had to deconstruct everything we knew about cleaving and start all over. The only accounts, about cleaving, useful for the interpretation of the original boards seemed to be the two mentioned above but they did not give a complete description. By forensic interpretation of hundreds of medieval boards and rafters we in a way have acted as apprentices to past craftsmen.[16] As beginners in the craft an interplay between experiment and forensic interpretation was necessary so new patterns could be observed. Slowly we could distinguish previous overlooked traces and which of the tool marks that were the results of conscious choices or results of haphazard mistakes. By this method, we approached the medieval craftsmen’s viewpoints and could see that *spårning* is a timesaving and effective way to control the cleaving procedure. That it allows warped trees to be cleaved successfully with resulting boards that are not stronger than sawed but good enough for the intended purpose. That it is no problem to make four boards from one log as long as no big branches or twig humps are present on the log, and that cleaving not have to be more wasteful than sawing.

Practical experiments



Fig. 6 Boards, 6.2 metres long, resulting from a successful cleaving of one log into four boards. Photo Mattias Hallgren.

A series of reconstructive experiments have been performed since the winter/spring of 2012. The best time for cutting down the trees and cleaving and hewing the timber into boards and rafters is in March. In this period, there is enough daylight to work fairly long days and workable timber that is not completely frozen.

The following description concerns our present standpoint in cleaving of boards, guided by our observations and sources. The most essential difference in our present procedure of cleaving boards in comparison with our first experiments is that we now use wedges to a much lesser extent.

The procedure follows a scheme. Straight trees without too many branches are selected, felled and shortened with an axe. If a tree is not perfectly straight, we place the ridge upwards. The log gets debarked where the snapped soot line will be made. The log then is turned 180 degrees to make corresponding lines. Since the first cleaving will go through the marrow, this step is important. The log gets placed on its side and the scoring begins, first on one side and then on the other. The log then again will be placed with the ridge upwards. The wood between the scores on both sides will be cut away. The sides then will be hewed to a smooth surface using the *sprätthuggning* technique. The timber will be turned on its side and the same procedure will be repeated to get a boxed heart.

Now the actual cleaving process will start. A soot line will be made on both small sides to mark the position for the first cleaving. The *spårning* starts and will be done at least twice on each side. Wedges will be inserted in the incision, and crossing fibres will be cut. The procedure will be repeated several times until the timber gets cleaved into two parts. Finally, the cleaved marrow sides will be hewed so that the process can start over with the second cleaving.

After two seasons of successful experiments I became quite confident. So when we were to make new roofing boards for Ingatorps tithe barn we had no doubt that we would make four boards from one log. I got a bit sloppy and did not examine the original boards before we went to the diocese forest just 2 km from the tithe barn. In the forest I noticed that all of the trees had twig bumps low on the stem. We did our best but soon realised that we would not be able to do more than two boards from each log. When I then examined the original roof boards I noticed that the craftsmen had had the same problem or presumption as we had with twig humps and they also only managed to make two boards from one log. In the season 2016 I and my colleagues made one cleaving experiment that succeeded in eight boards from one log. Technically it was no problem to achieve but it is generally more time efficient to make four boards out of a smaller log.

One of the most extraordinary and demanding experiments done so far was the aim to reproduce rafters of the impressive length 13 metres. This experiment was done in the diocese project "Medieval roof trusses in the diocese of Strängnäs". The original rafters were found in Hardemo church spire and documented by carpenter Daniel Eriksson. This experiment can be seen as a spin off of the previous experiments and would most probably have been unsuccessful if we had not had the experience from these. By examination of the extant rafters a hypothesis could be established.[17] Daniel and I thought it might be possible to get 8 rafters from one log 13 metres long. A tree was chosen with a stem that was almost round, and not oval as is common. The tree was also very straight and free from branches except in the top.

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Fig. 7 During the season 2014 we made an experiment with producing four 7 metres long rafters from one log. The boxing and the cleaving was done where the tree was felled. The rafters can be seen in between the stump and the top of the tree. The waste was minimal. Photo Karl-Magnus Melin.



Fig. 8 From one log we could produce eight 13 metres long rafters. The two rafters to the left are completed. We carried out the completed rafters with no problem. Photo Daniel Eriksson.

Future experiments

The door in Södra Råda was made from oak and in 2017 we will cleave boards for a reconstruction of this door. A big problem concerning oak is that it is very hard to find oaks that corresponds to the ones used in the 11-12th century in the diocese of Lund and for the door in Södra Råda in the 14th century. For example, a recently made dendrochronologically analyse of an oak window frame from Fulltofta church in Scania gave the information that the lintel piece contained 399 annual rings on a width of 32 cm. The width of the frame is 32 cm and the annual rings are the rings closest to the core were still almost parallel which told us that the used oak had at least had a diameter of one metres and the tree started to grow in the 6th century.[18] In current Sweden it is more or less impossible to find oaks of this quality. In the case of the reconstruction of the door for Södra Råda we will have to use an oak with much smaller diameter and much wider annual rings. This might of course have an impact on

the results. It would also be of great value to do experiments with producing radially cleaved oak rafters that corresponds to the documented in the diocese of Lund.

Transfer of tacit knowledge

As the experiments give us more understanding and skill in the art of cleaving it also raises question of how to transfer this tacit knowledge to others. There are different recipients, craftsmen, antiquarians, parishioners and the public. Therefore, we who are involved in the reconstruction use different medias since no media alone can fulfil the goal. One way is to write articles like this and the previous ones, which work well for academics but not as a sole way of transferring the knowledge to other craftsmen. We have made documentary films that combined with the papers give a better understanding for the craft if you are initiated and can read the movements and subtle choices that not all can be told. Even better when possible is to transfer the knowledge in workshops. But for a successful transfer of knowledge it requires that the recipient is able to repress previous craft knowledge and embrace alternative knowledge that might contradict previous assumptions.

On the Craft laboratory's YouTube page, there is one film called "A log is boxed and cleaved".[19] In this film we make two rafters out of one log. And the cleaving experiment made for the diocese of Strängnäs also resulted in a documentary.[20]

Discussion

The methods of cleaving may seem to follow simple procedures, but from a practice-led research perspective this is an illusion. For each step in the procedure, there are a multitude of circumstances and problems, as well as variations and alternative solutions. In fact, so many alternatives that it is impossible for us to try and evaluate them all. Despite this I am optimistic about our experiments and results and believe that we have come close to the procedures of medieval cleaving. In our experiments, we reached the conclusion that the trees are individuals with different characteristics and that it is necessary to have a "dialogue" with each tree to get to know them and "cooperate" with them to get a successful result.

I also believe that if we could meet and work with the medieval craftsmen they would understand what we do and why, even if they would have some different ideas about some of the steps.

We have had the opportunity to do full-scale experiments over a period of many seasons, in different forests, on frozen and unfrozen timber, on pine and spruce, timber with straight fibres and warped, and with different end products. This makes us feel much more secure in the art of cleaving and interpreting traces of the procedure. Tasks that would have seemed almost unachievable now seem only to be depending on the problem to find forests with trees that corresponds to the original material investigated in the churches.

It is very hard to do an experiment where the work is done in a natural flow and in the same time to document what is done and why. It can be compared by driving on the highway and drop the steering wheel to write down how you manage to drive a car fast and what judgements to be made in order not to crash. Even if we do document the processes by our self we have found it to be a good complement to have a documentary filmmaker to film some of the experiments.

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I and my colleagues also deconstruct or knowledge when we put our historic 19th century craft knowledge lowest in the hierarchy and the extant medieval boards and rafters highest and medieval illustrations and texts in between. The ability to all the time contest our own results in order to get a bit closer to a reality that has past has let us see new clues where we earlier saw nothing of interest.

Tim Ingold writes "*In the academic pantheon, reason is predestined to trump intuition, expertise to trump common sense, and conclusions based on the facts to trump what people know from ordinary experience or from the wisdom of forbearers*".[21] All this trump can be dangerous and misleading. It takes responsiveness to work by intuition, humbleness to distinguish the context of the expertise and the so called common sense and the ability to criticise what facts and why they are chosen and lastly to be aware of that we have multiple forbearers from very different contexts and also with different perspectives and wisdoms.

So instead of vainly declaring how it was done, it is better to put forward possibilities of how it could have been done based on the sources we have at hand. Our definition of craft research is not to be content with measurable hard facts[22] but also to create possibilities to experience and draw similar conclusions about the craft as the historical craftsmen. Not as a handyman that invent workable ways to get the job done but instead work as humble apprentices before the masters of the past and redo the experiments, when possible, until the result equals the originals both in details and variation.

A successful cleaving is quite a euphoric experience, after many hours of working with a timber suddenly everything happens quite fast and it gets critical to make the right decisions in order to not end up with a failure.

In this perspective, a secular craftsman in the 21 centuries can, at least in one way, understand how the meaning of one of the verses in the Gospel of Thomas could make sense for a medieval craftsman. Verse 77: "Jesus said: *Cleave a wood and I am there.*"[23]

Acknowledgment

The research in the article was initiated through the following projects:

The reconstruction of Södra Råda church, Historic carpentry art in the diocese of Lund, the restoration of Ingatorp tithe barn and Medieval rooftrusses in the diocese of Strängnäs.

The author's research also is part of a doctoral project called *Sacral carpentry art* at the University of Gothenburg. I would like to acknowledge the contributions by Daniel Eriksson whom I been working with in all of the experiments. Gunnar Almevik as a cowriter of previous papers in the subject. Petter Jansson and Heikki Ranta as coworkers in *Historic carpentry art in the Diocese of Lund*. Börje Samuelsson and Lennart Grandelius from the restoration project of Ingatorp tithe barn and Hans Lindersson for dendrochronologically analysis and discussions. Haio Zimmermann for translating the German fable and Richard O. Byrne for checking the spelling and grammar.

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16. G. Åberg, Skånska klockstaplar. In Skånes hembygdsförbunds årsbok. 1942

Notes

- [1] Almevik & Melin 2015 and 2016
- [2] Eriksson & Torgén 2016 and Eriksson 2017
- [3] Kardell 2004:205
- [4] Åberg 1942:71
- [5] Hjelmberg 1789

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- [6] Leche 1746
- [7] Kalm 1772
- [8] Since a lot of the findings has been done in cooperation with my colleagues in the reconstruction of Södra Råda I refer to we instead of I where accurate in the text.
- [9] Melin 2009
- [10] This might also have been the case in a medieval church building, as members of the parish may have provided the raw material.
- [11] Melin & Andersson 2008
- [12] The churches are Fulltofta, Hyby, Munka Ljungby, Stehag, Östra Sallerup and Övraby.
- [13] Eriksson 2016
- [14] Professor Haio Zimmerman helped me with translation from German.
- [15] Lyrics from The song "*Think for Yourself*" by Sub Hum Ans 1986.
- [16] In Melin (ed) 2014 we examine the selection of the best wood to rafters and warped wood used for less important struts in Granhult church dated to the 1220s.
- [17] Eriksson 2016
- [18] Melin in press. The frame is analysed in the context of Historic carpentry art in the diocese of Lund.
- [19] Documentary made by Craft Lab." *A log is boxed and cleaved into rafters*" https://www.youtube.com/watch?v=nz_d2E6xGCg&t=1283s (Last consulted 19 January 2017).
- [20] Documentary "Medeltida träklyvning- ett försök att återskapa hantverkskunskap." <https://digitaltmuseum.se/021116756077/olm-f-2016-3-1?pos=0&query=Medeltida+træklyvning> (last consulted 19 January 2017)
- [21] Ingold 2013:2
- [22] For hardfacts see Almevik & Melin 2015, 2016 and Eriksson & Torgén 2016.
- [23] Gospel of Thomas. <http://www.earlychristianwritings.com/thomas/gospelthomas77.html> (Last consulted 19 January 2017). It was discovered in December 1945 and was not known to the medieval craftsmen.