

Fig. 1 The skeleton of the loom: **a** side board, **b** post, **c** crosstie, **d** treadles, **e** frame heddle, **f** pulley block, **g** warp beam, **h** breast beam. ■

Model of a horizontal treadle loom

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● **The article presents a successful construction of a functioning medieval horizontal treadle loom.**

The following article presents the building of a functioning model of a horizontal treadle loom carried out on the basis of archaeological finds and iconographic sources. The project took place in 1998 at Archaeopark Liboc run by the ARCHAIA association in Prague, Czech Republic (*Bureš-Vařeka 2004*).

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Description of a horizontal loom

The base of a horizontal treadle loom (**fig. 1**) is a wooden frame consisting of four posts (two at the front and two at the back), two side boards (left and right) and two or four crossties connecting the frame across its width. The beams, side boards and crossties are joined by mortise and tenon and secured with wooden pegs.

On the front and rear posts there are placed two smooth rollers – at the front by the weaver there is a breast (cloth) beam and at the rear a warp beam. The warp threads are fixed to the breast beam and the finished cloth will gradually be rolled up onto it. The warp threads lead horizontally to the warp beam where they are fixed and wound as storage (the warp threads are always several times longer than the loom). The two beams are provided with ratchet wheels (tooth wheels) and with ratchet pawls or simple break sticks. These are at one end inserted in holes at the ends of the beams and at the other end they lean on pegs sticking out from the sideboards (for example **fig. 1** and **4**). As is also the case in our model.

The most important part of the loom is the spacing mechanism consisting of one or more frame heddles, two or more treadles (the number of heddles and treadles used depends on the type of fabric being produced), pulley block and reed. A wooden frame with a pulley block usually consisting of two pulleys is fixed to the sideboards, carrying frames with strands. These frames (frame heddles) consist of two parallel rods with strands, smooth waxed impregnated twines with an eye in centre, extended between them. The number of strands corresponds to the number of warp threads in the cloth and each warp thread passes through the central eye of one strand in one of the heddles in the way needed by the system of the chosen fabric structure. Each heddle is connected on its bottom side with a string to a treadle which the weaver controls with his feet. The alternate pressing and releasing of treadles causes the alternate rising and falling of single heddles (and that means also strands with warp threads) which creates shed/counter-shed for passing of the weft, that is a shuttle with bobbin with wound on weft threads.

The pressing in of the passed weft to the ready cloth is done with a swinging beater-in or reed, created by a rectangular frame filled with dense row of thin smooth teeth from reed splits. One or two warp threads pass through each gap depending on the width and density of the cloth.

The size of the loom is not constant or exact given. The size used to be derived on the one hand from the wanted maximum width of the future fabric and on the other from the size of the weaver himself (a loom used to be built to order for each person). The height of the loom would be between 150 and 200 cm, the width of the loom did not exceed the span of weaver's arms – this was very important as the weaver needed to pass the shuttle without problem from one side of the fabric to the other. The axels of both rollers, that means the working height was about 70 to 80 cm above the ground.

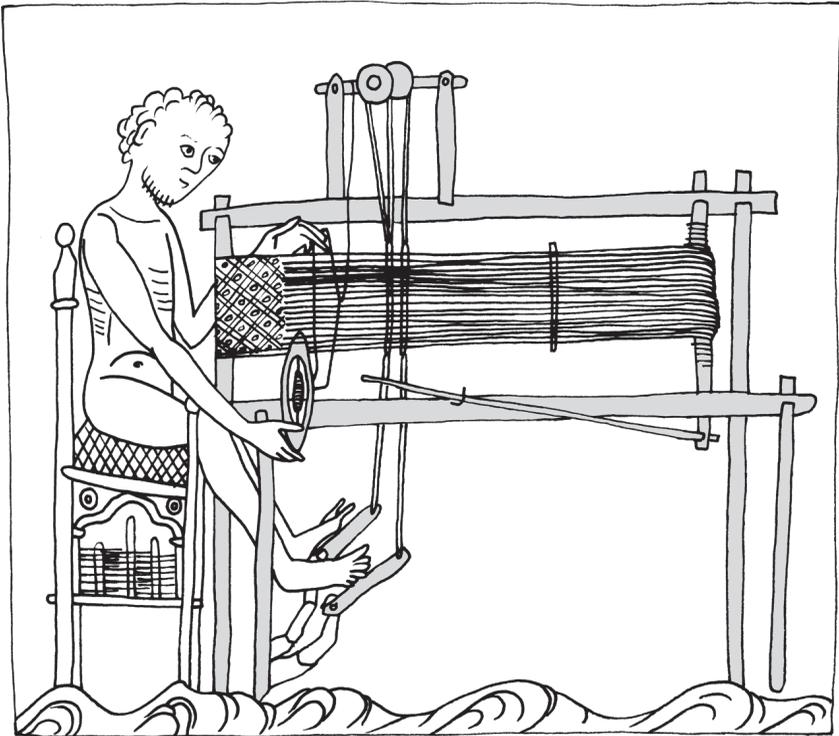


Fig. 4 The oldest known depiction of a horizontal loom, English manuscript, mid 13th century. ■

The horizontal loom in archaeological finds and iconographic sources

The horizontal treadle loom was a fully wooden manufacturing device so its remains or finds of single parts of it appear among archaeological artefacts. Despite this we can, on the basis of these scarce finds, especially from areas favourable to preservation of organic materials, gain information on the beginnings of use of this type of a loom in Europe, its construction, shape of single parts or even its placing within the weaver's workshop (description of a horizontal loom and history of its use with reference to further literature for example *Endrei 1961*, 121 -136; *Nahlik 1956*, 526 – 529; *Hoffmann 1964*, 258 – 259; *Fajmon 1990*, 7 – 13; *Maik 1997*, 48 – 56).

The invention of the horizontal treadle loom with horizontally stretched warp is attributed to China where its use is documented in the 2nd century BC. From there the knowledge of its use spread over time towards the west and during the Early Middle Ages Europe became acquainted with this new type of weaving device. Here the treadle loom became established fairly quickly and it gradually replaced the earlier used vertical loom with its vertically stretched warp.

The oldest preserved parts of a horizontal loom in Europe, dating to the 11th century come from Polish Gdansk, Russian Novgorod and German Haithab. Other sporadic remains of a horizontal loom, dating to the turn of the 12th century were found in Norwegian Bergen, Polish Opole and Gdansk. Finds from following centuries, when the horizontal treadle loom was the most common weaving device, are more common. Finds from the 13th to the 15th centuries are known from German Braunschweig, Swedish Sigtuna, Norwegian Bergen, Polish Elbląg and Kruszwica, Russian Novgorod and Maloye Toropickoye Gorodische, Latvian Riga and Koknese, Swiss Winterthur, Reinach, Murten, Mailand and English York (*Maik 1991; Maik 1997, 49 – 50; Windler – Rast-Eicher 1999/2000; Zariņa 1992*).

The most commonly occurring type of archaeological find connected to a horizontal loom, is a flat wooden disc with a central hole and a groove round the circumference (**fig. 2**), which was a part of the pulley used to hang the frame heddles. These discs of about 3 to 10 cm diameter are usually found either on their own, with the whole pulley or its remains (**fig. 3**). Further there are finds of fragments of heddles (sometimes with remains of warp threads, passing through eyes on the strands), wooden treadles, reeds for beating-in weft, breast and warp beams.



Fig. 5 Depiction of a horizontal loom from the 15th century. ■

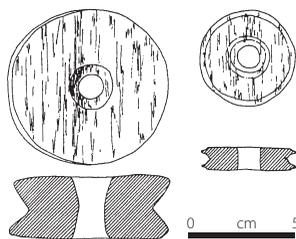


Fig. 2 Flat wooden disc with a central hole and groove around the perimeter, part of the pulley. ■

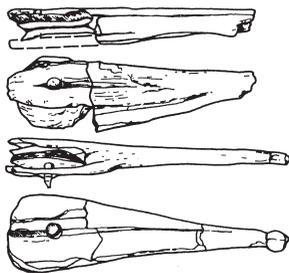


Fig. 3 Pulley block with a wooden disc. ■

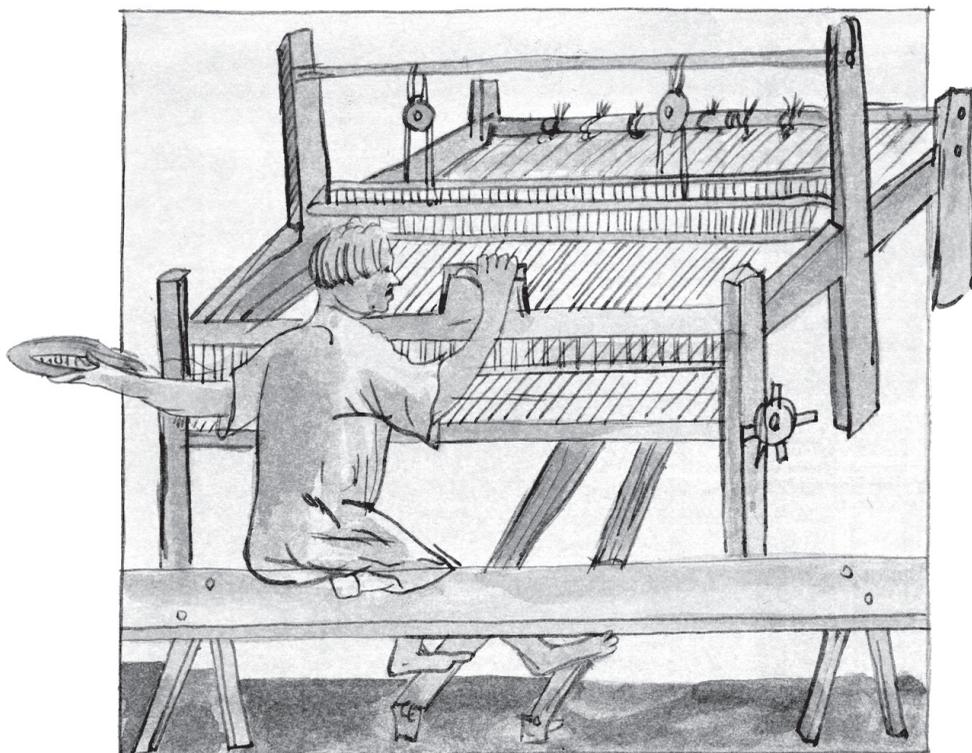


Fig. 6 Depiction of a horizontal loom from the 15th century. ■

Finds of the remains of the wooden skeleton preserved in situ, within the original workshop, are as yet rare. The find of four textile workshops destroyed by fire dating to the 13th to 15th centuries in Winterthur, Switzerland are unique in a European context. Aside from the remains of the horizontal looms, remains of fabric and tools used for cloth making were also preserved (*Widler – Rast-Eicher 1999/2000*).

There are not, as yet, any finds from Czechia which we can connect to a horizontal loom. On the basis of finds from neighbouring countries and knowledge of early and high medieval textile production we can suppose that its use spread to our countries around the second half of the 13th century, at the beginning in an urban context in connection with the development of a cloth manufacturing industries.

A number of depictions of horizontal treadle looms is known from medieval iconographic sources. They all show a similar frame skeleton with a weaving mechanism of various complexities, with a different number of heddles and treadles. The oldest known depiction of a horizontal loom originates from an English manuscript from mid 13th century (**fig. 4**). Many details of the construction of a two-treadle loom including the system of fixing the weaving (spacing) mechanism are noticeable on two other pictures from the 15th century (**fig. 5 and 6**).

Procedure for the construction of a horizontal loom

The project itself – detailed sketches of the single parts of the loom as a source material for the carpenter (**fig. 13**) – was based on the oldest known iconographic sources and a drawing reconstruction of archaeological finds from an early medieval Viking town Haithab-Hedebea (**fig. 1**; *Elsner*, fig 54).

The model of the horizontal loom was constructed, in accord with the documentation, by Mr Michal Daňa from Brno. He used three types of wood to build the loom: spruce, birch and ash. Most of the parts of the loom were made from spruce – parts of the skeleton from planks 50 mm thick, both rollers and a pole carrying the pulleys from trunks. All the joints (**fig. 8**) were made with pegs turned out also from spruce. No nails or screw were used in building the loom. The bodies of the two pulleys were cut out of birch, the movable disks turned from ash (**fig. 10**). Spruce was used because nowadays it is the most accessible material (the situation in Middle Ages may have differed), birch because it is soft and it is easy to cut, ash on the other hand is a hard wood suitable for turning. Planing, turning and drilling was carried out mechanically, all other work manually. The making of single parts took about a week, the assembly on spot took another day.

The loom was placed within the interior of a sunken building. The workshop function of these structures is documented from many archaeological sites. Because of its size we had to assemble the loom in its final position – inside the building as the finished loom would not pass through the narrow door.

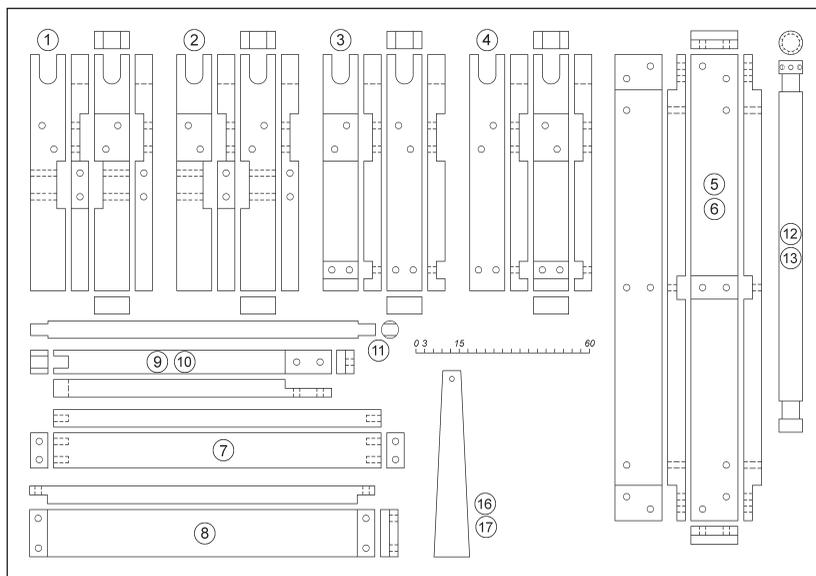


Fig. 13 Document for the carpenter showing single parts of the loom. ■

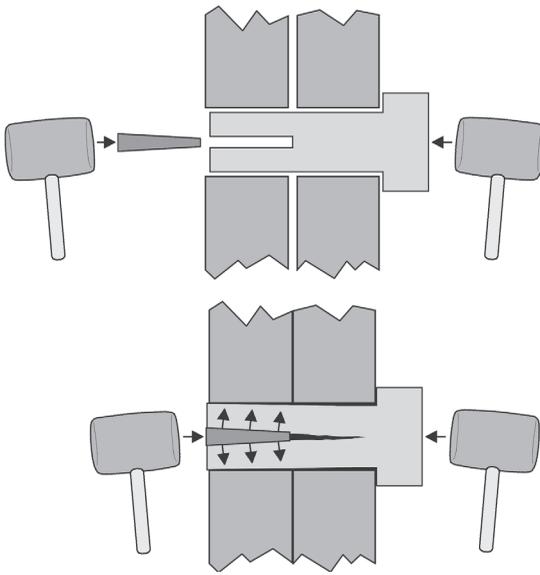


Fig. 8 Joints in the construction were secured with spruce pegs. ■

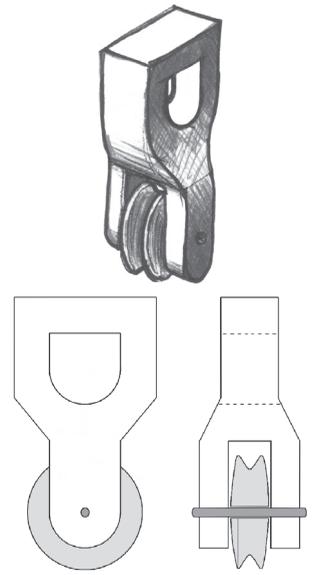


Fig. 10 Pulley block with a wooden disc. ■

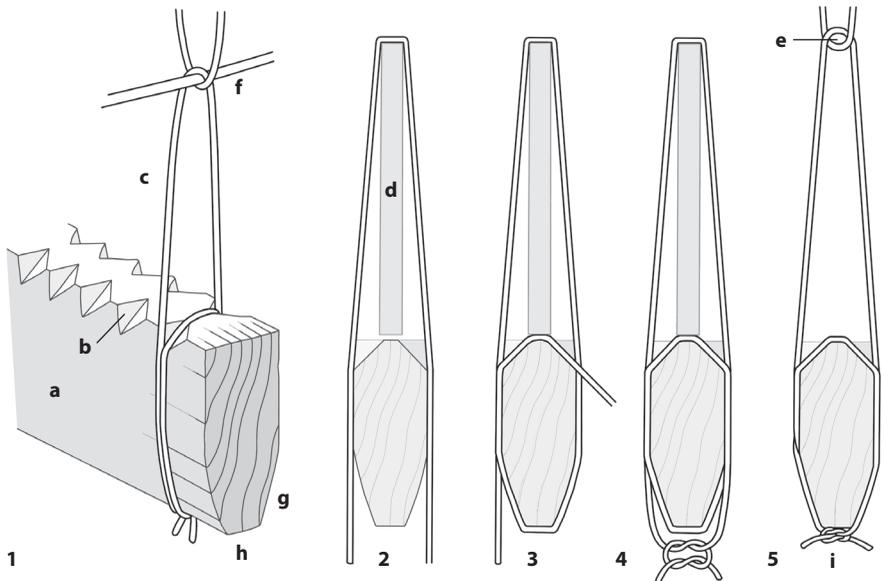


Fig. 12 Fastening of the strands. ■

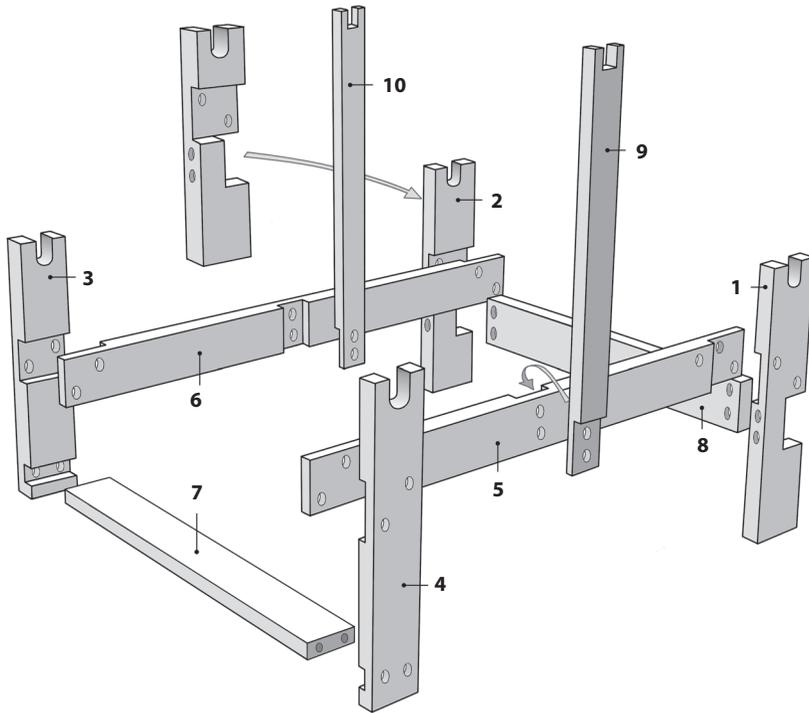


Fig. 7 Construction method of loom assembly. ■

When assembling the loom first the side boards (**fig. 7: 5, 6**) were with pegs and wedges (**fig. 8**) fixed to the appropriate legs (**fig. 7: 1-4**). Then uprights were added (**fig. 7: 9, 10**), carrying the pole with the pulleys. These parts were connected by crossties (**fig. 7: 7, 8**). Then both rollers were placed in position (**fig. 9: 12, 13**), and the pole (**fig. 9: 11**) with pulleys (**fig. 9: 14, 15**). This finished the assembly of the 158 cm long and 118 cm wide skeleton of the loom (**fig. 14**). The axes of the rollers are 76 cm above ground, the axis of the pole with the pulleys 138 cm above ground. The last step was the fitting of pulleys and treadles (**fig. 9: 16, 17**) and putting in of the weaving (spacing) mechanism (**fig. 11, fig. 15**).

The making of the frame heddles and the fitting of the strands was the most demanding task of the whole construction (**fig. 12**). Each frame consisted of two identical halves – upper (**fig. 11: A**) and lower rod (**fig. 11: B**) on which there are at regular intervals fixed strands. The number of strands corresponds to the number of the warp threads. In the centre between the two rods, at the place where the strands from the opposing rods connect, has to be created an eye where later the single warp threads pass through. The strands have to be both on the top and bottom fixed at identical distances. Therefore we cut into the edges of the rods (**fig. 12: a**) at identical intervals grooves (**fig. 12: b**) leading the strands (**fig. 12: c**) in the intended direction (**fig. 12: 1**). Both rods were on opposing sides cut length

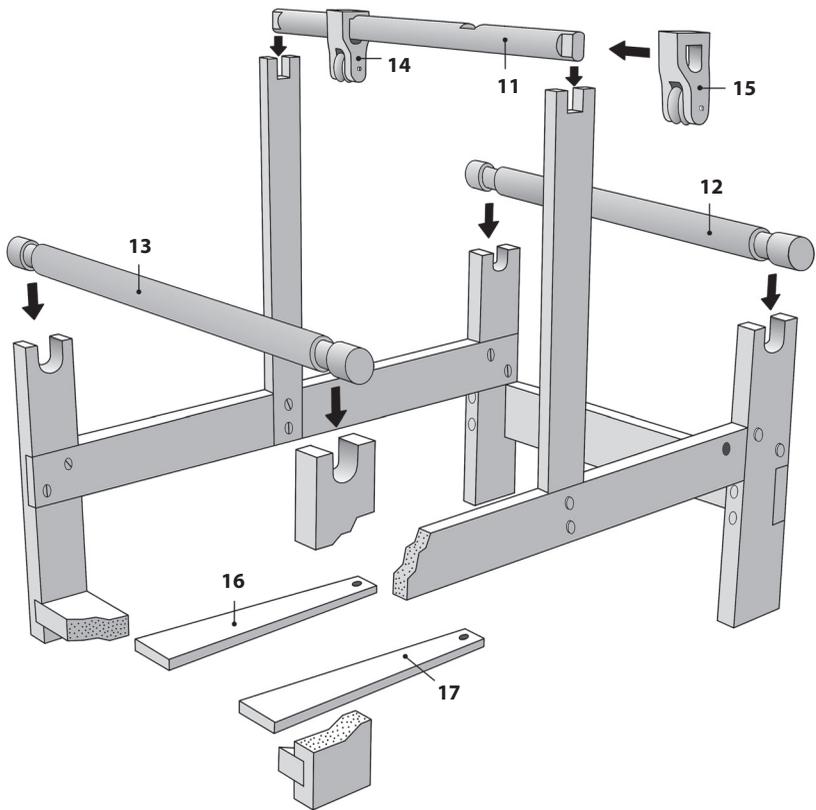


Fig. 9 Construction method of loom assembly. ■

wise (**fig. 12: g**) so that there was only one edge (**fig. 12: h**). It make it easier to tie a not which fixes each strand (**fig. 12: i**). All the strands have to be of identical length so that all the passing warp threads are at the same height. Otherwise the passing of the shuttle through the shed/ counter-shed would be either difficult or impossible. Therefore when fixing the strands to the rods (**fig. 12: 2-4**) we used a thin board (**fig. 12: d**), as long as the rod and 8 cm wide so that all the strands being fixed leaned on it and after fixing they all ended 8.5 cm from the rod. The second half of the frame was made in the same way, only the strands were not fixed independently but passed through a loop on the end of the strands of the first half. This created eyes (**fig. 12: e**) for passing through of the warp strands (**fig. 12: f**). In the end the finished frame heddles with strands were fastened with strings to treadles and connected over a pulley with each other (**fig. 11**). The frame heddles are 40 cm long although due to the width of the loom they could be up to 100 cm long. We intentionally chose shorter frame heddles, the length of which restricts the width of the produced fabric, to make it easier in the stretching of the warp as in this early phase of weaving we intended to gain experience with work on a horizontal loom.

Weaving on the model of a horizontal loom

After finishing the assembly of all the parts of the loom we started to test it by the weaving of 20 to 30 cm wide strips of fabric in a plain pattern (**fig. 16**). The successful results showed that the construction of the loom and especially the spacing mechanism was correct and functioning well.

Since August 1998 when the model was finished the loom has been kept functional and been used by visitors to Archaeopark Liboc, who can try weaving for themselves (**fig. 17**).

Final note

The aim of this contribution was to present a successful construction of a medieval horizontal loom, the first of its type in the Czech Republic. We intended to collect information on horizontal loom from archaeological finds and depictions in medieval sources, to build on their basis a functional loom and to test the weaving of wide strips of fabric in all of which we have succeeded. Thus we created a starting point which will allow us to start the more difficult task of formulating and carrying out real “weaving” experiment which would enrich our knowledge of medieval cloth making.

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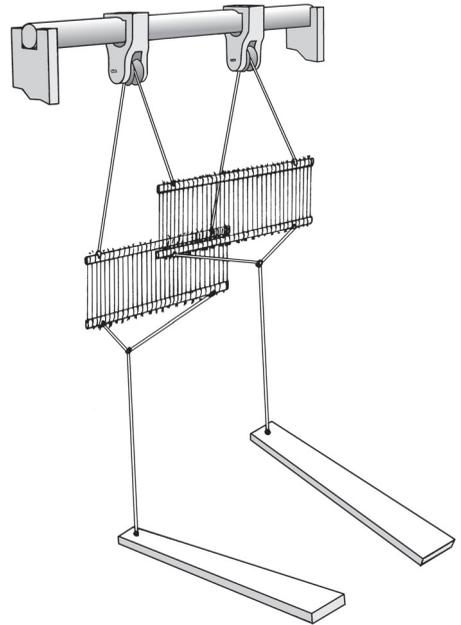


Fig. 14, 11 Installation of the weaving mechanism. ■

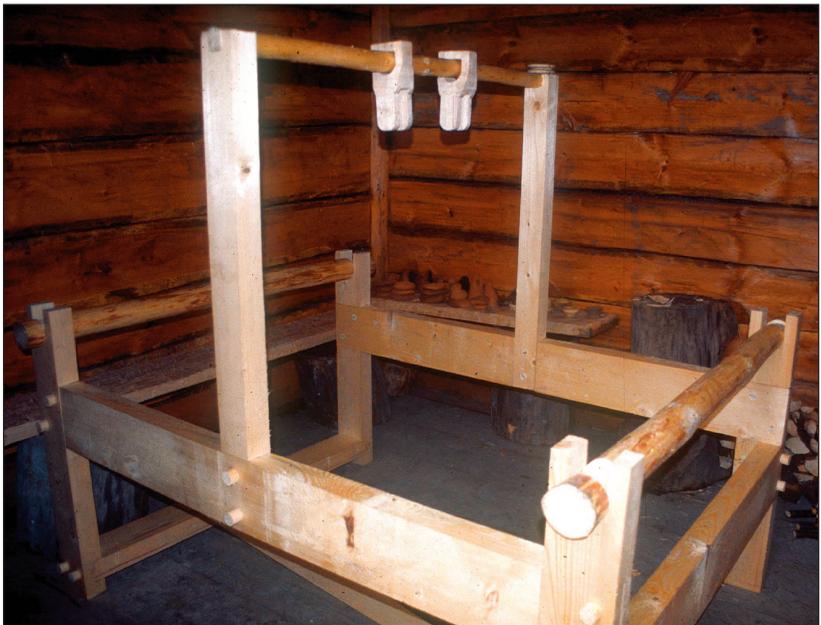


Fig. 15 Installation of pulleys. ■

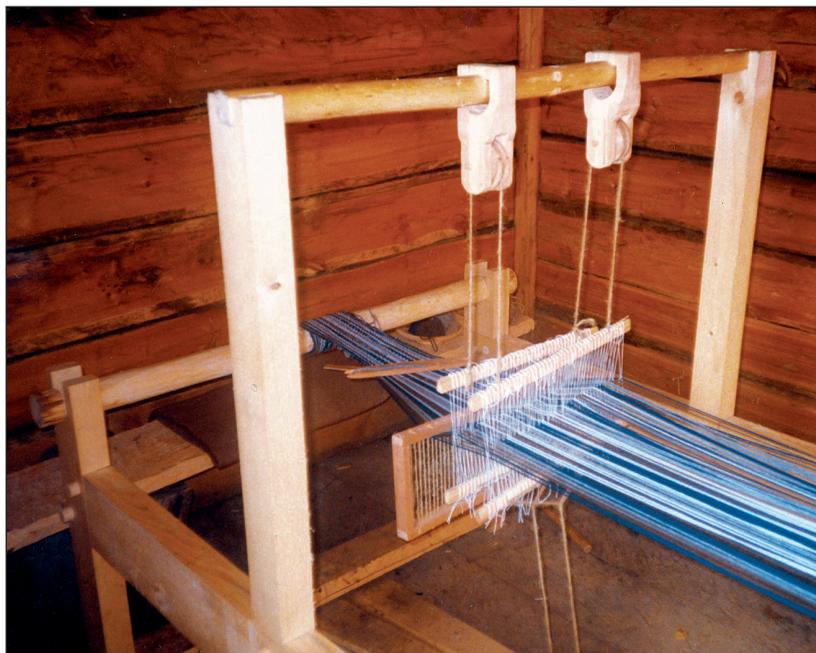


Fig. 16 Installation of the weaving mechanism. ■



Fig. 17 Exhibiting the loom in Archaeopark Liboc ■

Summary

Das Modell eines horizontalen Webstuhls

Dieser Artikel stellt den Bau eines funktionstüchtigen Modells eines horizontalen Webstuhls vor, der auf der Basis archäologischer Funde und ikonographischer Quellen durchgeführt wurde. Während es vom Gebiet Tschechiens keine frühen Funde gibt, die mit einem horizontalen Webstuhl in Verbindung zu bringen sind, können wir doch auf der Basis von Befunden aus benachbarten Ländern und aufgrund der Kenntnis frühmittelalterlicher Produktionsweisen darauf schließen, dass er in der zweiten Hälfte des 13. Jh. hier bereits bekannt war. Die Projektarbeiten selber basierten auf den ältesten bekannten Bildquellen und auf zeichnerischen Rekonstruktionen archäologischer Funde aus der frühmittelalterlichen Wikingersiedlung Haithabu bei Schleswig.

Der anspruchsvollste Teil der gesamten Konstruktion war die Herstellung der Rahmenteile und die Befestigung der Fäden. Nach Abschluss des Zusammenbaus des Webstuhls wurde er mit fabrikmäßig hergestellten Wollfäden für die Herstellung eines einfachen Musters getestet. Die Tests waren erfolgreich und zeigten an, dass der Mechanismus funktioniert.

Reconstitution d'un métier horizontal médiéval à tisser

L'article décrit la reconstitution d'une réplique du métier horizontal à tisser, réalisée à partir des vestiges archéologiques et des sources iconographiques. Aucune trace qu'on puisse associer à un métier horizontal ancien à tisser ne sont attestées en République tchèque; cependant, sur la base de vestiges provenant des pays voisins et des informations sur la fabrication des tissus en haut Moyen-Age, l'utilisation du métier à tisser se serait répandue dans le Royaume tchèque vers la deuxième moitié du 13^e siècle. Le projet même - plans détaillés des différentes parties du métier qui ont servi à un menuisier professionnel comme ingénierie - a été réalisé sur les sources iconographiques les plus anciennes et les reconstitutions théoriques à partir des vestiges archéologiques découverts sur la ville de Vikings de Haithab-Hedeba, datant du haut Moyen-Age.

Réaliser les lisses constituait la phase la plus difficile de cette expérience. Enfin, le métier à tisser étant monté, on l'a testé en tissage d'une bande à l'armure toile. Les expériences réussies ont prouvé le caractère fonctionnel du dispositif.