

Computerised production line of carpentry products – processing centre Hundegger K-2

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Abstract: Electric hand tools like for example sawing, mortising, milling, grinding, drilling or sanding machines for wood processing have been commonly used in carpentry however lately in carpentry more and more computer programmes are being used - based on CAD such as WETO, SEMA or DIETRICH. These programmes used in construction projecting cooperate with digitally driven processing centres such as for example Hundegger K-2 and K-3 which are able to perform with high accuracy the most difficult and complicated elements of roof rafter framing. It saves time 30% in joints production with the same precision of performance.

Keywords: carpentry, roof rafter framing, joints

INTRODUCTION

Roof is a construction covering a building and protecting its interior against unfavourable influence climatic factors. Wood construction of roof is roof rafter framing [1, 2, 3].

Wood delivered for roof construction or to carpentry business performing a roof has dimensions close to required ones. To process needed elements or constructions squared logs should be sorted and well-matched to a given place and construction.

That is why we can state that during carpentry work we have to deal with:

- selection of wood,
- distribution (tracing) of elements,
- machining, mainly transverse and oblong cutting, shaping elements and dimensioning them,
- machining aiming at another type of cutting that is performing and building up of joints (mortising, drilling wholes etc.),
- impregnation of wood,
- assembly of elements in the place of building-in.

In order that the machining is performed properly and elements during fixing go together machining places have to be adequately traced. The base for allocation is architectural project, working or workshop drawings according to which markings of natural dimensions are performed. They can be drawn on boards or panels. Markings for big constructions are drawn on floors made from smooth boards or panels. [4]

Although firms make effort to precisely perform joints; precision of joining rafters leave lot to be desired.

Hence attempts to construct equipment making easier to accomplish with high accuracy the most difficult and complicated elements of roof rafter framing. The first automatically driven devices for wood cutting were constructed in the beginning of the sixties of twentieth century /Fezer 1963/.

DEVICES FOR CARPENTRY PRODUCTION

In 1984 Hans Hundegger demonstrates facility for performing carpentry joints driven by a computer, which was used for building houses of frame construction (timber frame). Also other firms at that time develop a wide range of facilities for carpentry production from very

simple solutions (AVOLA) to very complicated ones (e.g.: KRÜSI AG, UNITEAM) [<http://www.kruesi-ag.ch/website.php>]

Carpenters started to build houses with timber frame construction using computer programmes (e.g.: CADWork, Zirbel, S & S, Dietrich, Sema). In general data from projects are passed on to computer driving production line (manually or automatically).

The computer decides which tools to use for production of a given element (e.g. column – Pin joint) and how to produce elements from a given set of tools in the most effective way. www.hundegger.de/ (august 2010)

HANS HUNDEGGER 6-AXIS MULTI-OPERATION MACHINE TOOL FOR TIMBER ELEMENTS FOR BUILDINGS' CONSTRUCTION

Hundegger K-2 robot is a machine tool designed for accomplishment of roof rafter framing. One can perform on it not only rafter framing but also hip rafters, valley rafters, jack-rafters, angle braces, columns purlins and wall plates additionally all elements of stairs can be prepared as well.



Fig.1. Machining centre Hundegger K-2 [www.hundegger.de/]

The main advantage of this model is machining with one fixing of material in clamping jaws of two feeding carriage which determines material in relation to machining tools. It is even included in the name of machining machine K-2 "Zweihandsystem".

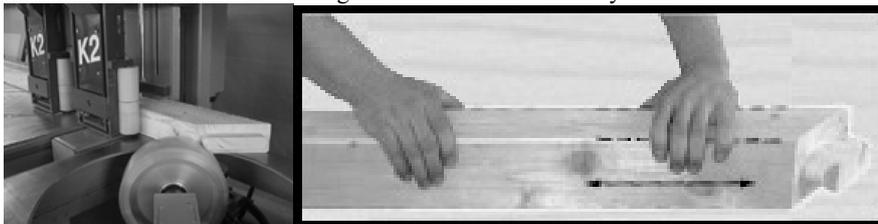


Fig. 2 and 3. The work principle of mobile wagons during joint milling [www.hundegger.de/]

The new transport and positioning system with two guide and positioning wagons gives accurate cuts even with bowed or twisted timber.

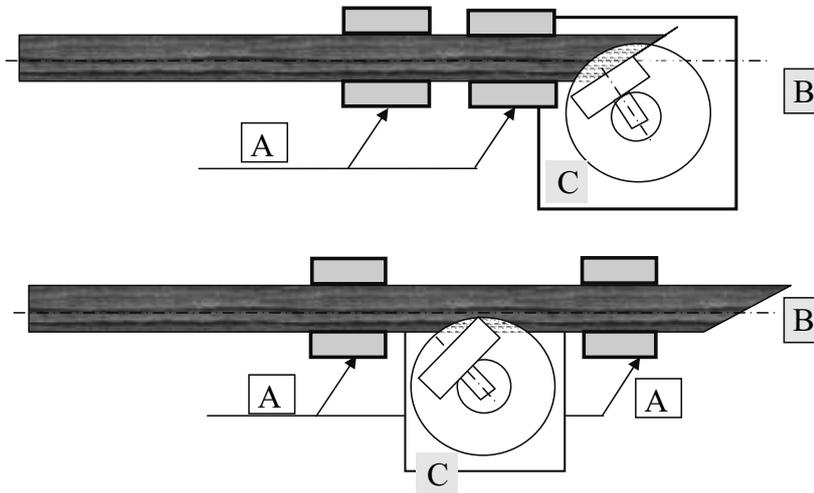


Fig.4. The scheme of work principle of carpentry products line:

- A: guide and positioning wagons, different wagons settings in reference to machined tool
- B: reference line,
- C: the universal mill.

This principle is of course also valid for the other tools such as saw, drill units, milling etc. The wood is held in position directly at the point of operation, so that a bow or twist does not affect the accuracy of the joinery (fig 3.)[5].

Performing tolerance: 1/10mm -x axis, 1mm over 8 m - y axis.

Hundegger 6-axis multi-operation machine tool is additionally equipped in:

- driving centre equipped in computer with monitor,
- multi-functional disc saw which enables cross cutting of timber which has traverse dimensions from 20 x 50 mm to 300 x 450 mm (optionally 625 mm or 1250 mm) at any length (from 0,8 m),
- high-precision feed rolls and chain ones (punctually covered with rubber),
- cutter head with possibility of fixing shank cutter or plain milling one,
- drilling head with possibility of fixing different length and diameter drills,
- chain saw enabling performance of very precise cuts with perpendicular edges,
- possibility of data input via EKP programme with graphical presentation or from all available programmes Abbund and CAD.

Intelligent multi-process driving enables rational working process (machining) without classification of timber elements. Timber elements are taken for processing and next automatically is chosen construction element (from earlier prepared list) best fitting downloaded material. The element is machined and after working process is marked as finished.

Another element enabling performance of different cut-outs in logs is usage of turn table or space enabling rotation of spindle base at 360° in different plains.

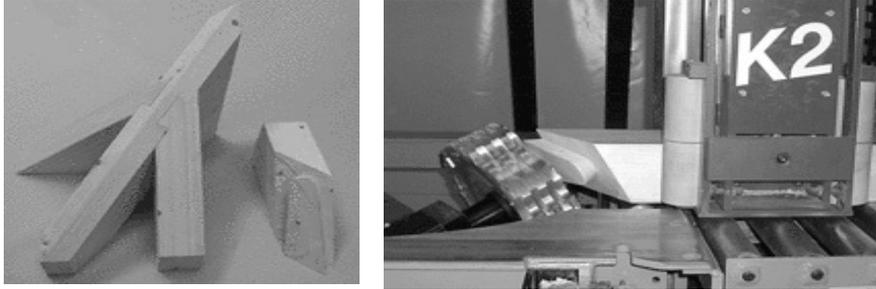


Fig. 6. With the 5-axis mill, compound conical dovetail connections can be precisely milled on rafters, hip and valley beams.

6-axis machining unit with 5 degrees of freedom enables additionally change inclination axis and milling angle, make wholes including conical wholes, grooves etc. 6-axis machining can perform so complicated timber joints which are presented in Fig 6, 7 and 8 at low costs.



Fig. 7. Log milling - one can notice possibility of change of axial location of working spindle.

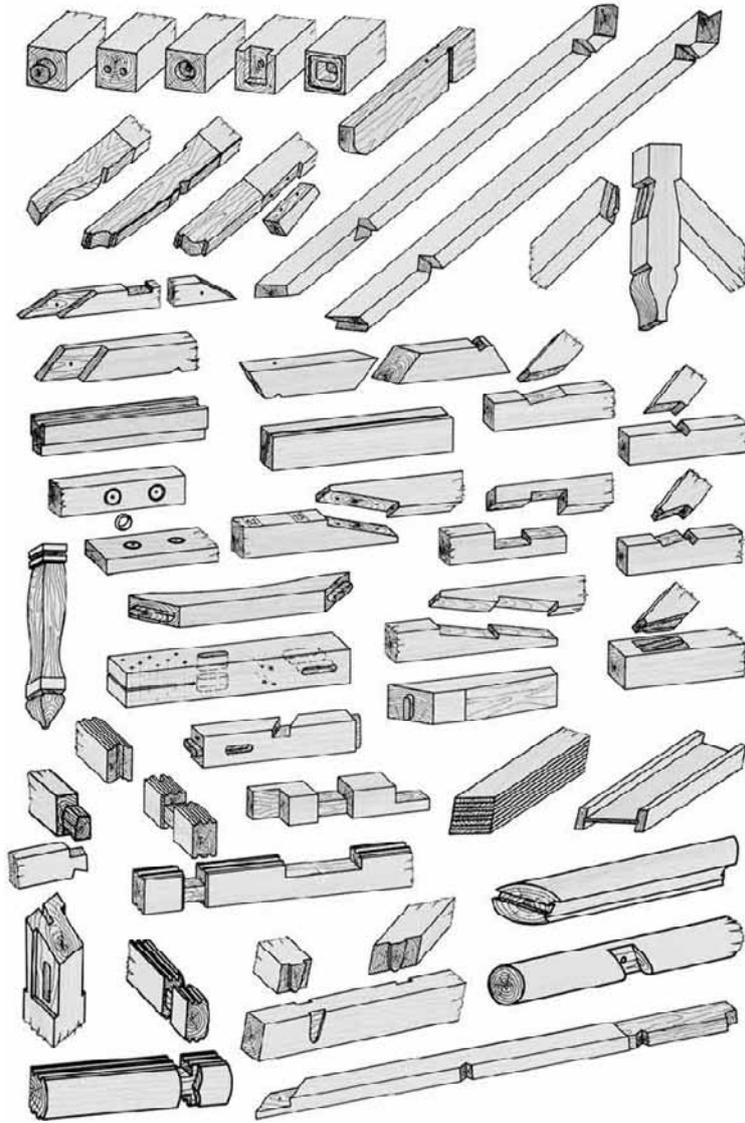


Fig.8. Samples of carpentry elements made by K2 Hundegger production line[www.hundegger.de].

CONCLUSIONS:

Using Hundegger K-2 robot for production of carpentry elements allows very precise, fast and economical production of new and traditional patterns of timber constructions. As all machines it is dependent on experience and knowledge of operator. Usually elements are machined collectively (cutting, milling, drilling, marking) which raises performance precision in comparison with precision of traditional carpentry methods. The K-2 robot needs only one

person with fork-lift truck for servicing. The disadvantage is high price starting from 120 000 EUR.

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Streszczenie: *Skomputeryzowana linia do produkcji wyrobów ciesielskich - centrum obróbcze Hundegger K-2.* W artykule opisano linię do produkcji wyrobów ciesielskich K-2 firmy Hundegger. Przedstawiono dwa rozwiązania na których bazuje obrabiarka a mianowicie: system podawania i mocowania elementów drewnianych w czasie obróbki z pomocą dwóch wózków ze szczękami mocującymi elementy. W obrabiarce zastosowano 6 osiowy system obróbczy z 5 stopniami swobody dla możliwości obróbki z każdej strony belki. Przedstawiono przykładowe możliwości wykonania elementów więźby dachowej na omawianej linii. Zastosowanie linii Hundeggera do wykonywania elementów ciesielskich pozwala na bardzo precyzyjną, szybką i ekonomiczną produkcję elementów konstrukcji drewnianych. Elementy obrabiane są zazwyczaj łącznie (cięcie, frezowanie, wiercenie, znakowanie) co znakomicie podwyższa precyzję wykonania w porównaniu z dokładnością konwencjonalnych metod wykonywaniu stolarki. Do obsługi potrzebna jest tylko jedna osoba z wózkiem widłowym. Wadą jest cena zakupu nowej maszyny zaczynająca się od około 120.000 euro.

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