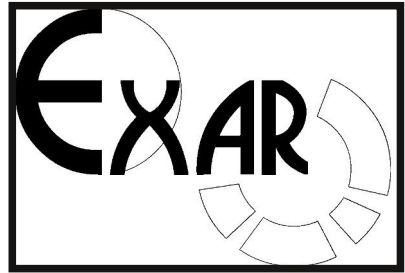


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## Different solutions for a simple design: New experiments on tablet weave HallTex152 from the salt mine Hallstatt

Maikki Karisto and Karina Grömer

**Zusammenfassung – Viele Wege führen zum Ziel: Neue Experimente zum Brettchenwebband HallTex 152 vom Salzbergwerk Hallstatt.** Das Salzbergwerk Hallstatt, in dem hunderte Textilien organisch überliefert sind, ist eine wichtige Quelle für unser Verständnis zu textilen Techniken, besonders der Älteren Eisenzeit. Gerade bei den Forschungen zu den Brettchengeweben stellt die Experimentelle Archäologie ein wichtiges Element dar. Das Brettchengewebe HallTex 152, das im vorliegenden Beitrag im Fokus steht, stellt vordringlich ein eher simples Design aus der Eisenzeit dar, welches auch in anderen zeitgleichen Handwerken der Hallstattkultur Anwendung fand, so auf Keramik oder Bronzeblecharbeiten. Dieses vor über 2500 Jahren entwickelte Muster hat vor allem in den letzten zehn Jahren weite Verbreitung auch im Internet gefunden, sowohl bei Reenactmentgruppen, als auch bei verschiedenen Interessenten an alten Handwerks-techniken (siehe Grömer, in diesem Band).

Dabei hat sich herauskristallisiert, dass es verschiedene Zugänge zu diesem Muster gibt, verschiedene Möglichkeiten, mittels Brettchenweberei ein derartiges Design zu kreieren. In diesem Beitrag werden nun sieben davon vorgestellt. Bei diesem detaillierten Experiment wurde das Brettchenwebband HallTex 152 mit verschiedenen Befädelsvarianten und Drehdynamiken rekonstruiert. Diese verschiedenen Lösungsansätze werden in Bezug auf das Originalband diskutiert. Dabei muss eine frühere Publikation zu einem Rekonstruktionsvorschlag der Brettchenwebtechnik revidiert werden.

*Schlagworte: Textilfunde, Brettchenweberei, Frühe Eisenzeit, Salzbergwerk, Hallstatt, neue Experimente, Hallstattzeit*

*Keywords: textile finds, tablet weaving, Early Iron Age, salt mine, Hallstatt, new experiments, Hallstatt Period*

### Introduction

The salt mine Hallstatt is an important source for different kinds of organic finds – leather, textiles, wooden artefacts and many more. We know of hundreds of textiles, which have survived in an organic

state. The textile finds are from the Bronze and the Iron Ages and cover a timespan between c. 1500 and 400 BC (overview: GRÖMER ET AL. 2013). The major corpus of textiles is derived from the Early Iron Age and thus reflect the textile culture of that time. We know of different



weave types (twill and its variants are very common), patterns and dyes. Such, the salt mine is important for our understanding of textiles and textile techniques of the Hallstatt Period. In the following paper, we discuss the tablet woven bands, in particular HallTex 152 and offer new experiments for its recreation.

#### Tablet woven bands from the salt mine Hallstatt

To set the tablet woven band HallTex 152 into its context, a short characterisation of the Hallstatt bands and other finds is presented. At the salt mine Hallstatt, we know of six tablet woven items (HUNDT 1960, Taf. 30; GRÖMER 2004; GRÖMER, RÖSEL-MAUTENDORFER, RESCHREITER 2014, 136-138), one is dated to the Bronze Age, the others have been found in the Early Iron Age parts of the salt mine. The widths of the Iron Age items vary from 0.6-1.3 cm and they are woven separately as narrow widths. So far, from Iron Age Hallstatt we do not have a hint for a tablet woven item that serves as woven-on selvedge, starting border or the like.

There is a variety of techniques for creating patterns among the tablet woven items from Hallstatt. Three of them, one from the Bronze Age (HallTex 288) and two dating to the Iron Age (HallTex 43 and 136) are very simply made with stripes created through continuous turning of the tablets, each dressed with a single colour (four-hole warp twined tablet weaving). To our current knowledge, HallTex 288 is the oldest preserved, colour-patterned (blue striped) tablet-woven textile in Europe with a date between 1500-1200 BC (GRÖMER, RÖSEL-MAUTENDORFER, RESCHREITER 2014, 136).

Three further Iron Age tablet weaves from Hallstatt feature designs such as meandering lines, solid triangles and diamonds (HallTex 123, 152 and 186; see also reconstructions in: GRÖMER 2004). The light,

yellow-beige patterning on a dark, two-tone ground (green and dark brown) is dynamic and remains similar to its original colour to this day, due to the preservative qualities of the salt mine. The tablet woven bands are the only Hallstatt textiles with motifs that diverge from basic textile designs, such as stripes and checks, and thus have typological relevance. A com-



Fig. 1: Tablet woven band HallTex 152 from Hallstatt salt mine, c. 800-400 BC. – Brettchengewebe HallTex 152 aus dem Salzbergwerk Hallstatt, c. 800-400 v. Chr.

	warp			weft
	yellowish	brownish-black	olive-green	brownish-black
<b>NCS-Code</b>	S3040-Y10R	S8010-Y30R	S8010-B30G	S8502-B
<b>Single or plied yarn</b>	plied yarn	plied yarn	plied yarn	single yarn
<b>Twist direction</b>	S	S	Z	z
<b>Twist angle</b>	50-60°	40-50°	40-50°	30°
<b>Thread diameter</b>	0.4-0.5	0.3-0.4	0.4	0.4
<b>Thread count</b>	44 threads/cm			8-10 threads/cm

Fig. 2: HallTex 152: Technical Data. – HallTex 152: Technische Daten.

parison of the triangular design and meandering lines with contemporaneous ceramics from the Hallstatt and Early La Tène Periods, similarities become evident (see GRÖMER ET AL. 2013, fig. 30; SCHAPPELWEIN 1999). The technique applied in weaving HallTex 123 and 186 is double-faced 3/1 broken twill combined with warp-twined diagonal stripes (see also COLLINGWOOD 1996, 230-231) – the weaving technique of HallTex 152 was the aim of our new experiments.

As we know so far, complex patterned tablet-woven bands could be identified in Europe only from the Hallstatt Period onwards (compiled study: GRÖMER, STÖLLNER 2009). Important finds were made in Verucchio in Italy, between 725 and 650 BC (RÆDER KNUDSEN 2002), the chieftain's grave in Eberdingen-Hochdorf in Germany (RÆDER KNUDSEN 1999, 80-82) and the elite burial of Hohmichele (BANCK-BURGESS 1999, 202-203), dated to the Late Hallstatt Period, and the La Tène Period band from Dürrnberg salt mine in Austria (GRÖMER, STÖLLNER 2009, fig. 4 and 10). Favourite designs are hooks, wavy lines and patterned triangles; often, these are repeated throughout the cloth. Most of the tablet-woven fabrics from other find spots have lost their original colour, because they survived as mineralised items on metal objects. Only the weave type can then be discerned.

#### Tablet woven band HallTex 152

Band HallTex 152 (see GRÖMER ET AL. 2013, catalogue p. 483), was found in the year 1991 during archaeological excavation works by Fritz Eckart Barth at the findspot Kernverwässerungswerk of the Hallstatt salt mine. The artefact is stored at the Natural History Museum Vienna with the inventory number 89.870.

HallTex 152 is a 1.2 cm wide tablet-woven band and it was sewn onto a yellowish fabric (HallTex 152B), from which just one yellow thread (S-plied yarn, 1 mm diameter) remained. The tablet woven band is torn at both ends, so that a 12.5 cm long fragment remained (Fig. 1).

The raw material used for the band is wool. After wool-measurements carried out by Michael RYDER (2001, Tab. 1), the wool of the warp threads is of a generalised-medium type, that of the weft threads are a hairy-medium type. The colours of the textile are described as they appear now, it has to be taken into account that they might have changed their appearance during use and discard in the mine to a more dull hue than when the threads were freshly dyed. The colour description follows the standardised code of NCS (Natural Colour System; NCS\_2016).

For the following experiments, the technical data of the textile is of importance (Fig. 2). The warp threads consist of plied

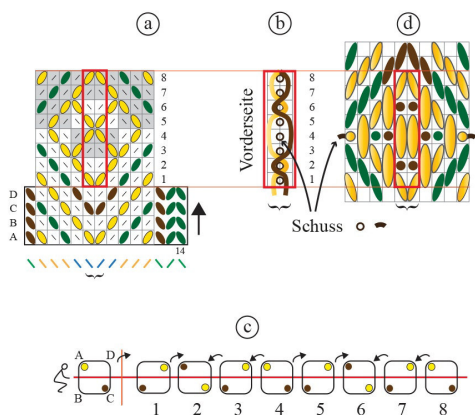


Fig. 3: Pattern drawing and weave structure. – *Webbrief und Bindungsbild.*

yarn with 0.4 mm thread diameter on average, the twist direction differs among the colours used. For the yellowish threads 0.4-0.5 mm S-plied yarn is used, the brownish-black ones are slightly thinner with 0.3-0.4 mm S-plied yarn. The olive-green threads are Z-twisted and 0.4 mm in diameter. As we usually recognize with tablet woven items, the twist angle of the threads used for the warp system is quite high. That is necessary because low twisted threads easily break during the tablet weaving process. For the weft, brownish-black single yarn was applied, z-twisted and 0.4 mm thick.

The pattern of the band can be described as yellow lozenges filled with a yellow X on olive-green and brownish-black background. The pattern field is surrounded by one tablet with brownish-black threads on one side and a brownish-black tablet followed by two tablets with olive-green threads on the other side.

The structure and pattern of the band – lozenges with cross-filling – led to a first reconstruction of its weaving technique, which was first published more than ten years ago (GRÖMER 2004, 146, fig. 3 and 6). Since then, different people worldwide made attempts to weave that band (see Grömer, in this volume), and they have

come to different solutions on how to make it. Most of those experiments can be followed on websites like pinterest (Pinterest\_Hallstatt\_2016) or private Homepages (Aisling\_Hallstatt3\_2016), in a few cases, pictures of those alternative experiments have been scientifically published (CRUMBACH 2007, 78).

Below are a series of new experiments. They are comprised of not only the different solutions found in the internet, but also further systematic experiments, including a discussion with the original find.

## Experiments

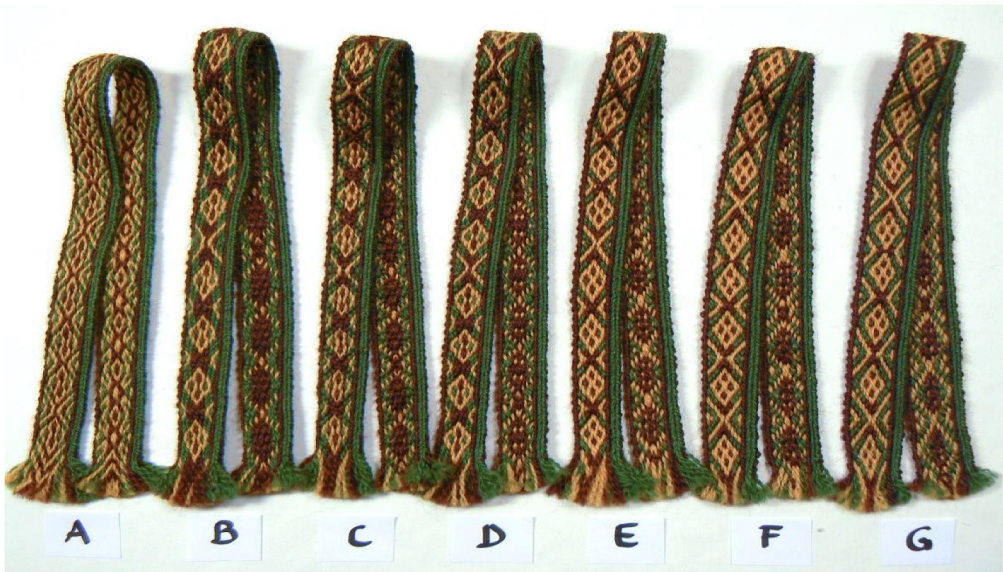
Tablet weaving (COLLINGWOOD 1982; HANSEN 1990) uses tablets that were usually square and pierced with holes at the four corners. The technique of how the warp and weft threads are interwoven relies on turning the tablets. As mentioned above with the original finds, there are different techniques that can be applied.

After re-analysing, the next step for reconstructing HallTex 152 was detailed visual studies of the front and back-side of the band in order to obtain information about the weaving technique. To visualize the technical system behind the tablet weave, a pattern drawing was applied (see KARISTO 2007; KARISTO 2010, 28-33; KARISTO, PASANEN 2013) that shows the threads used as well as the turning direction (Fig. 3). In the figure one can see: a) is the weaving diagram (Webbrief), d) a technical drawing of the pattern, b) the cross-section at the central warp threads and c) the threading of the tablets and the turning direction.

As the experiments aimed to provide a technical re-analysis of the weaving technique, there was no attempt to recreate the whole chaîne opératoire, including fleece selection, preparation or spinning. Such experiments have been carried out – e.g. for the tablet woven band HallTex 123 (RÖSEL-MAUTENDORFER, GRÖMER, KA-



Original  
front      back



<p>┌──────────┐</p>		<p>┌──────────┐</p>		<p>┌──────────┐</p>		
<p>4 threads/ tablet</p>		<p>3 threads/ tablet</p>		<p>2 threads/ tablet</p>		
<p>8 pattern tablets</p>		<p>8 pattern tablets</p>		<p>8, 10 and 12 pattern tablets</p>		

Fig. 4: Seven test bands in comparison with HallTex 152. – Sieben Probebänder im Vergleich mit HallTex 152.

NIA 2012). For the following experiments, wool yarn was used of a thickness and quality comparable to the original band HallTex 152.

To get an overview over possible variations, seven test weaves were made using square tablets with four holes. The test weaves vary according to the number of

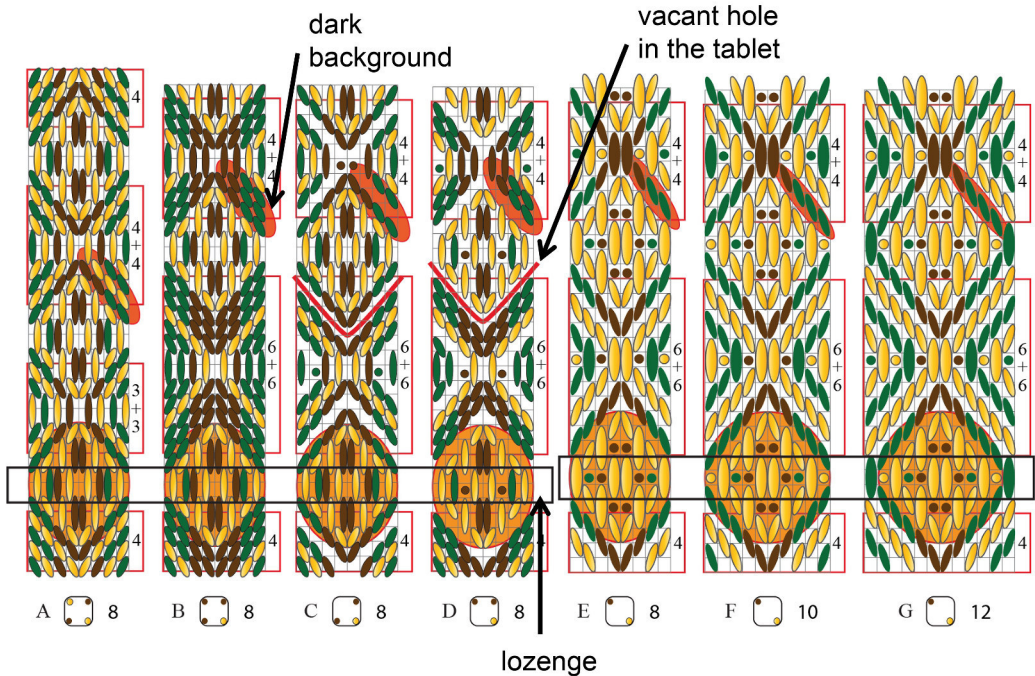


Fig. 5: Drawing of technical details of the seven test bands. – Technische Detailanalyse der sieben Prohebänder.

tablets used and the threading system (Fig. 4)

Test weaves: number and threading of the tablets

The variations are just within the pattern zone in the centre of the band, while the four tablets forming the selvedge were not altered. For all bands, on one selvedge a tablet threaded with four brown threads was used, on the opposite selvedge there is one tablet with four brown threads and two with four green threads each.

The variations in the pattern zone are as following (Fig. 4-5): The first bands A and B were made with eight tablets in the pattern zone. In A, the four holes of the tablets were threaded with alternating yellow and green or brown threads. For band B, the four holes of each tablet were threaded with one yellow thread and three green or brown ones.

The variants C and D were also woven with eight pattern tablets, but there, just three threads were inserted, one yellow and two dark ones; one hole was left without a thread.

The “missed-hole-technique” was also followed for test weaves E, F and G. For them, the two-hole technique was applied, i.e. threading two opposite holes with yellow and green/brown respectively (see HANSEN 1990, 17; 37, “double-faced weave with two threads in each hole”). The variations for the last bands are in the number of pattern tablets used; band E was made with eight, band F with 10 and band G with 12 tablets for the pattern zone.

Weaving and analysis of the test bands

For the experiments, each of the seven set-ups of warp was woven using distinctive turning sequences to obtain the ap-



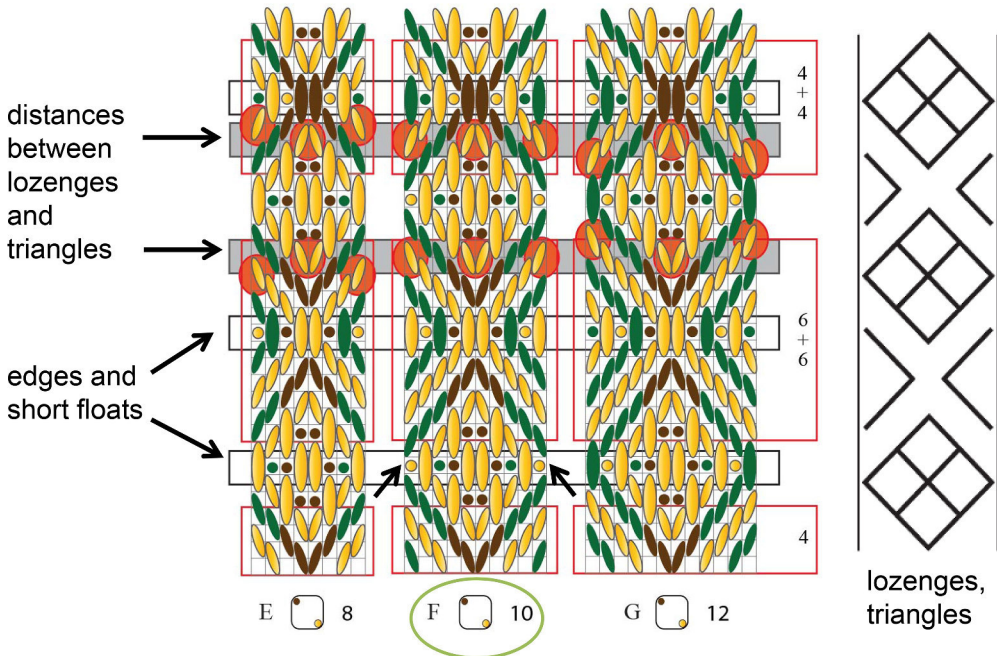


Fig. 6: Drawing of technical details of test bands E-G. – Technische Detailanalyse der Probebänder E-G.

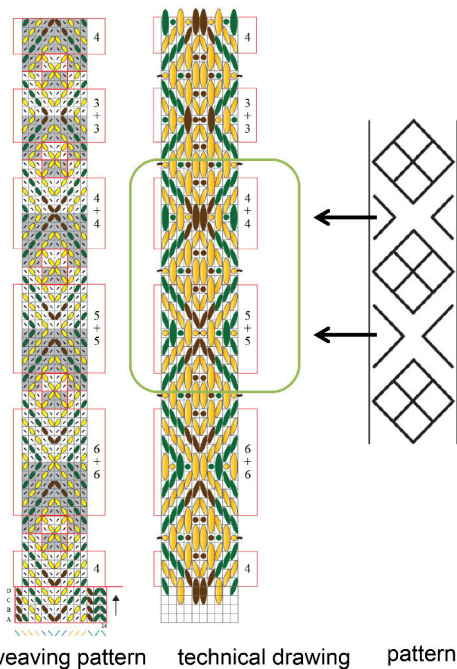


Fig. 7: Test band F, pattern repeat (triangles). – Proband F, Drehsequenzen bei den Dreiecken.

pearance of the original band. In some cases 4 turns forward and 4 backward were carried out, in the other cases 6 times forward and 6 times backward.

The test weaves were analysed again and compared with the original band. Detailed technical drawings of the pattern (Fig. 5) were helpful to detect even smallest variations. Interesting details have been the appearance of the dark background between the yellow pattern threads (marked with red oval). Also the visual appearance of the lozenge pattern (marked with orange circle) varied within the different band set-ups. At least the non-threaded holes on band C and D had an influence on the pattern (red V-shaped line).

A very distinctive hint to exclude certain test variants was a comparison of the backsides of the original find and the test bands. Such, it was quite sure that bands A-D didn't represent the way how HallTex 152 was woven.

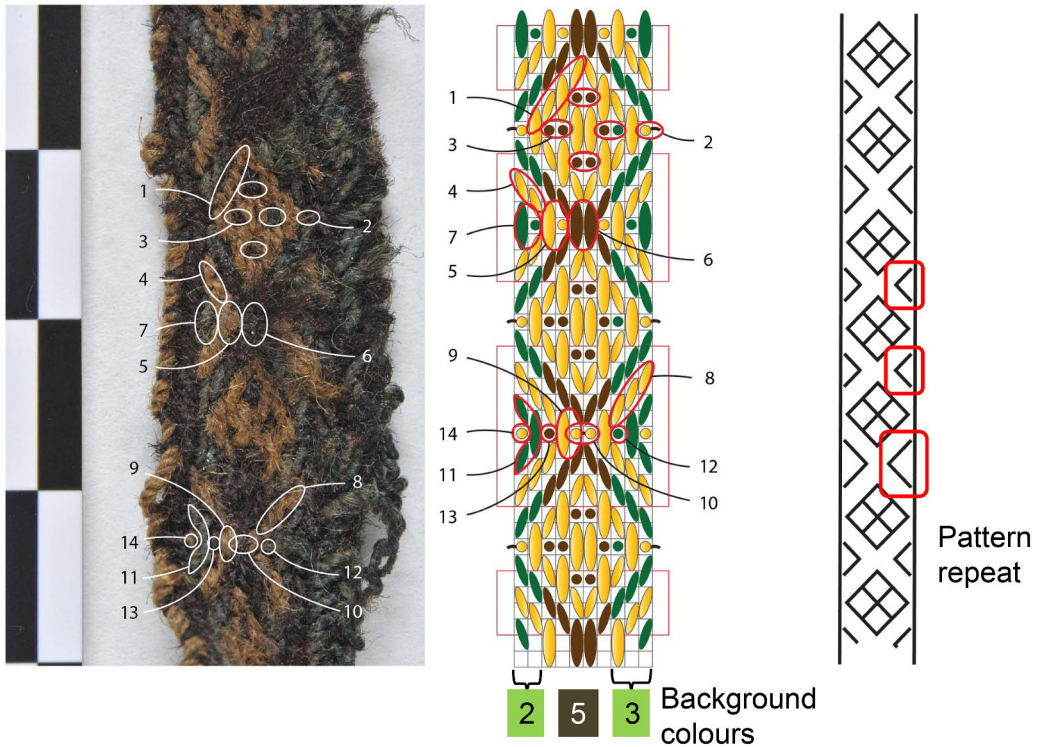


Fig. 8: Comparison between test band F and HallTex 152. – Vergleich zwischen Probeband F und HallTex 152.

It must have been a tablet woven band in two-hole-technique. Further emphasis was drawn on bands E, F and G to find out, how many pattern tablets were in use. Therefore, specific details of the pattern were analysed, such as the distance between the lozenges and the triangles, as well as edges and short floats of the threads on the areas where the turning direction of the tablets changed (Fig. 6). In that respect, test weave F is the one closest to the original.

HallTex 152 is in a way tricky, because the triangles, which give somehow a “frame” to the lozenges, do not have the same size. That led to various misunderstandings in reconstructions made by several people in the last ten years. To find out the correct size of the triangles, they were woven in four sizes, with a turning sequence of 3 forward/3 backward, 4/4,

5/5 and 6/6 (Fig. 7). As a result, it can be sure that a turning sequence of 4/4 and 5/5 was used to obtain the smaller and larger triangles that were alternatively (two small and one large one are repeated) woven on the band.

A further observation was made on this point (Fig. 8): the background colours have not been used in a symmetric way, as it was supposed before. Among the background colour, there are 5 brown threaded tablets in the centre, but on one side 2 green threaded and on the other side 3 green threaded ones.

#### Result of the test weaves

After the test weaves and the detailed analysis of all technical features, as well as a comparison of front and backside of the original band and the experimental

variants we can deduce that test band F represents the way how HallTex 152 was made (Fig. 8). 10 tablets were used for the pattern zone, threaded in two-hole-technique. Together with the tablets for the selvage zone, the band was woven with 14 tablets.

## Conclusions

The tablet weave in question seems to be a very simple design at the first glance. This band found its way via the internet to reenactment groups, Do-it-Yourself communities as well as modern artists (see K. Grömer, in this volume). All of them have their different ways to recreate the pattern. We presented seven new experiments including the suggestions from the internet community. Detailed experiments were carried out with different threading concepts for the weaving tablets and different weaving mechanisms and turning sequences. The different solutions to create that design were discussed in comparison with the original textile. The requirements for the experiment have been:

- high resolution photos of the front and the back of the original artefact,
- working, learning and discovering step by step,
- weaving test bands,
- drawing the weave structures in order to analyse the details.

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