TECHNICAL TEXTILE TOOLS REPORT FOR KHANIA, CRETE

A total number of 452 objects was recorded in the database. This number does not constitute the complete number of excavated textile tools. The objects are from 18 different excavation seasons (figure 1). However, the objects from the excavations 1989, 1990 and 2005 are under processing and have not yet been assigned a context date. This means that these tools are excluded from analyses that involve dated tools.

Excavation	Recorded textile tools
1970	22
1971	58
1972	3
1973	29
1974	9
1976	2
1977	89
1978	9
1980	23
1981	2
1982	28
1983	6
1984	31
1987	12
1989	19
1990	46
2001	20
2005	44
In all	452

Figure 1. Total number of tools recorded

Context date	No.
Pre-Protopalatial	7
Neopalatial	57
LM II/LM IIIA:1	23
LM IIIA:2	11
LM IIIB:1	38
LM IIIB:2	53
LM IIIC	56
Post-Minoan	98
In all	343

Figure 2. The number of recorded tools from Khania.according to context date.

As can be seen in figure 2, 23 objects are dated to an overlapping period, LM II/LM IIIA:1. These objects are under processing and it has not been possible for us to date these objects more precisely. Furthermore, 98 tools are from various periods after the Minoan. These objects are labelled Post-Minoan and they will be considered as one separate group. In all, 343 tools are included in the textile tool analyses (figure 3).

Context date	Spindle whorl	KS whorl	Spindle whorl/Bead	Loom weight	Spool	Pin/Pinbeater	Needle	In all
Pre-Protopalatial	3			4				7
Neopalatial			1	54		1	0(1)	56(57)
LM II/LM IIIA:1	3		3	10		7		23
LM IIIA:2		1	2	6	1		0(1)	10 (11)
LM IIIB:1	3	11 (14)	2	16(17)		1	1	34 (38)
LM IIIB:2	5	9 (16)	8	13	4	6	1	46 (53)
LM IIIC	8 (9)	11 (19)	3	7	18			47 (56)
Post-Minoan	22 (24)	35 (46)	5	13(14)	5	4		84 (98)
In all	44 (47)	67 (96)	24	123 (125)	28	19	2 (4)	307 (343)

Figure 3. The total number of objects recorded in the CTR database based on context date. The figures in parenthesis include objects that have been excluded as textile tools in the present analysis.

In the context analysis and the following discussion we will use the GSE research program system (pit, accumulated deposit, floor deposit, construction deposit and levelling deposit).

SPINNING IN KHANIA - SPINDLE WHORLS, KS WHORLS AND BEADS

A total number of 167 whorls were recorded in the database. However, three of the recorded spindle whorls and 29 of the recorded KS whorls are irregular in shape and/or the hole is not centred. These whorls would not have been the spinner's first choice as spinning tools and they have thus been excluded from the analysis. On the other hand, 67 KS whorls and 24 objects recorded as beads could function very well as spinning tools. Furthermore KHA-77-TC 002 has been reinterpreted as a spindle whorl and not as a loom weight.

To conclude: we have included 44 spindle whorls, 67 KS whorls and 24 beads in the analysis of the spinning tools from Khania

.

Material and type

As can be seen in figure 4, the majority of the spindle whorls and all the KS whorls are made of clay. The beads are made of both clay and stone. Only one whorl (KHA-71-B 002) was made of bone.

	Clay	Stone
Spindle whorls	33	11
KS whorls	67	
Beads	9	14
In all	109	25

Figure 4. The relationship between the material and the type of whorl. KHA-71-B 002, a small spindle whorl made of bone is not included in the figure.

The majority of the spindle whorls and the beads have a conical shape while the KS whorls in general are cylindrical or discoid (figure 5).

	Spindle whorls	KS whorls	Beads
biconical	6		2
concave conical			1
conical	16	5	15
conical with hollow top		2	
conical spherical	1		
convex	3		2
cylindrical	1	42	2
discoid	2	18	
flat spherical	2		
lenticular	3		
spherical	9		2
not avaible	1		
In all	44	67	24

Figure 5. The relationship between the whorls' type and shape.

All KS whorls are from LM III (figure 3) but otherwise there is no clear relation between the whorls' shape and date.

When comparing the weight and diameter of three whorl types' the analysis demonstrates a larger variation in weight and diameter within the spindle whorl group than the KS whorls and beads (figure 6). The KS whorls vary in weight from 4g to 35g and in diameter from 19.5 mm to 32 mm while the spindle whorls vary in weight from 1g to 75g and in diameter from 11 mm to 50 mm. The beads vary in weight from 1g to 19g and in diameter from 15 mm to 27 mm.

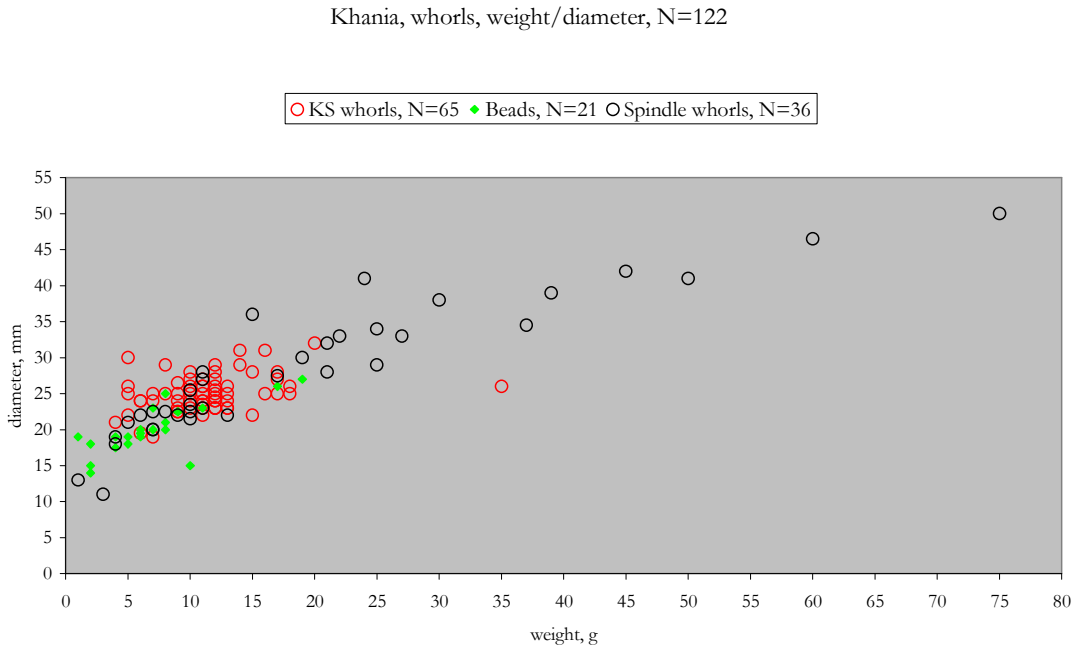


Figure 6. The relationship between whorl type and weight/diameter.

The KS whorls form a more homogenous group than the spindle whorls not only in shape, but also in weight and diameter. As can be seen in figure 6 there is a distinct cluster around a weight of 12g and a diameter of 25 mm. Furthermore, there are only very few spindle whorls which fall within this cluster of the KS whorls. In general, the spindle whorls are either smaller or larger than the KS whorls. This tendency is visible in whorls deriving from LM IIIB:1, LM IIIB:2 and LM IIIC. The whorls from LM IIIB:1 vary in weight from 1g to 15g and in diameter from 13 mm to 29 mm. The yarn that could have been spun with these tools would be very thin or thin. There is no clear variation in whorl size between the periods LM IIIB:2 and LM IIIC These whorls all vary in weight from 2g to 39g and in diameter from 18 mm to 41 mm (figure 7). This means that the same types of threads, from very thin to thick, could have been spun during LM IIIB:2 and LM IIIC.

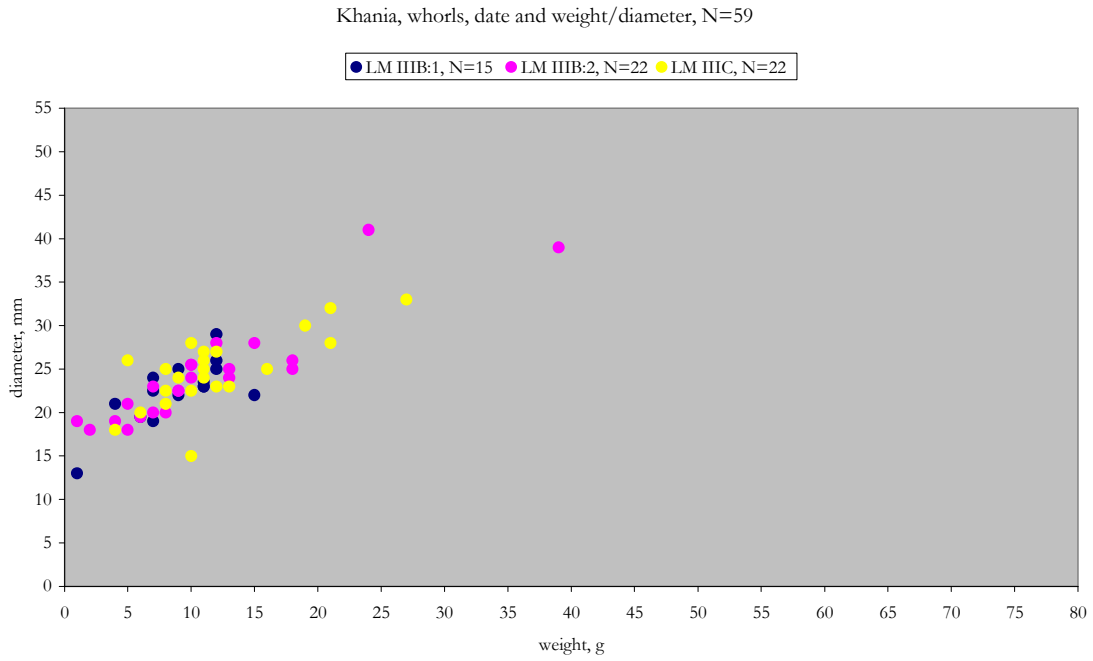


Figure 7. The relationship between date and weight/diameter.

		pit	accumulated deposit	floor deposit	construction deposit	levelling deposit
LM IIIB:1	Spindle whorl	2	1			1
	KS whorl	2	4	3	2	
	KS whorl?	1	1	1		
LM IIIB:2	Spindle whorl	3	1	1		
	KS whorl	6		2	1	
	KS whorl?	1	4	1	1	
	Bead	3	2	2	1	
LM IIIC	Spindle whorl	5	1	2		
	Spindle whorl?	1				
	KS whorl	3	4	3		1
	KS whorl?	2	1	3	1	
	Bead	1			1	
In all		30	19	18	7	2

Figure 8. The relationship between the type of find context, date and whorl type.

The whorls deriving from LM IIIB:1, LM IIIB:2 and LM IIIC are mostly from pits, but some whorls were also found in accumulated deposits and floor deposits (figure 8). There are no differences between the types of find contexts for the whorls we have interpreted as spinning tools and the whorls we have excluded. Neither is there any difference between the three periods in context types.

Spinning in Khania, a summary

The analysis of the whorls' weight and diameter indicates a varied production with emphasis on thinner yarn. Only few whorls derive from periods before LM III and it is

not possible to infer whether the types of thread the spinner spun in Khania changed during the occupational period. However, it is clear that the production of yarn did not change during LM III. It is interesting to note that the analysis indicates a production of primarily very thin and thin yarn. Some threads might have been as thin as 0.1-0.3 mm. This type of yarn would demand very well prepared raw materials. The fabrics produced with these threads would have taken a considerable time to make.

However, the people in Khania would also have needed coarser textiles e.g. sails but only a couple of spindle whorls seem fit for this type of production. Thus, it is likely that the excavated material is not representative for the entire production range and that other types of spindles (e.g spindles with whorls made of wood) also were in use.

LOOM WEIGHTS AND WEAVING IN KHANIA

A total number of 151 objects were recorded in the database. Because of its dimensions KHA-70-TC 021 has been reclassified from spindle whorl to loom weight. KHA-82-S 030, KHA-71-S 058, KHA-77-S 040, KHA-77-S 042 are all recorded as loom weights but they are made of stone and may have functioned as e.g. net sinkers.

Context date	conical	cylindrical types	discoid types	other	pyramidal	spherical types	spool	torus	unspec.	In all
Pre-Protopalatial			3						1	4
Neopalatial		6	7			40			1	54
LM II/LM IIIA:1		1	3	1		4			1	10
LM IIIA:2			6				1			7
LM IIIB:1		3	9	1		1			2	16
LM IIIB:2			11				4		2	17
LM IIIC			5				18	2		25
Post-Minoan	1	2	7	1	1	1	5			18
In all	1	12	51	3	1	46	28	2	7	151

Figure 9. The relationship between date and loom weight type. Note that the categories termed 'types' include all varieties of this generic shape. Thus e.g. 'discoid types' includes 'discoid', 'discoid rounded', 'discoid elliptical', and 'discoid tabulated'. For detailed information please see excel file *Khania figures* figure 9.

Figure 9 shows that there is no clear pattern of which types occur in which periods, but three types are more common than others: discoid, spherical, and spool shaped loom weights. The discoid loom weights are attested during the whole settlement period while the majority of the spherical loom weights is from Neopalatial period and the spools primarily from LM IIIB:2 and LM IIIC.

The weight and thickness have been estimated on 87 loom weights.

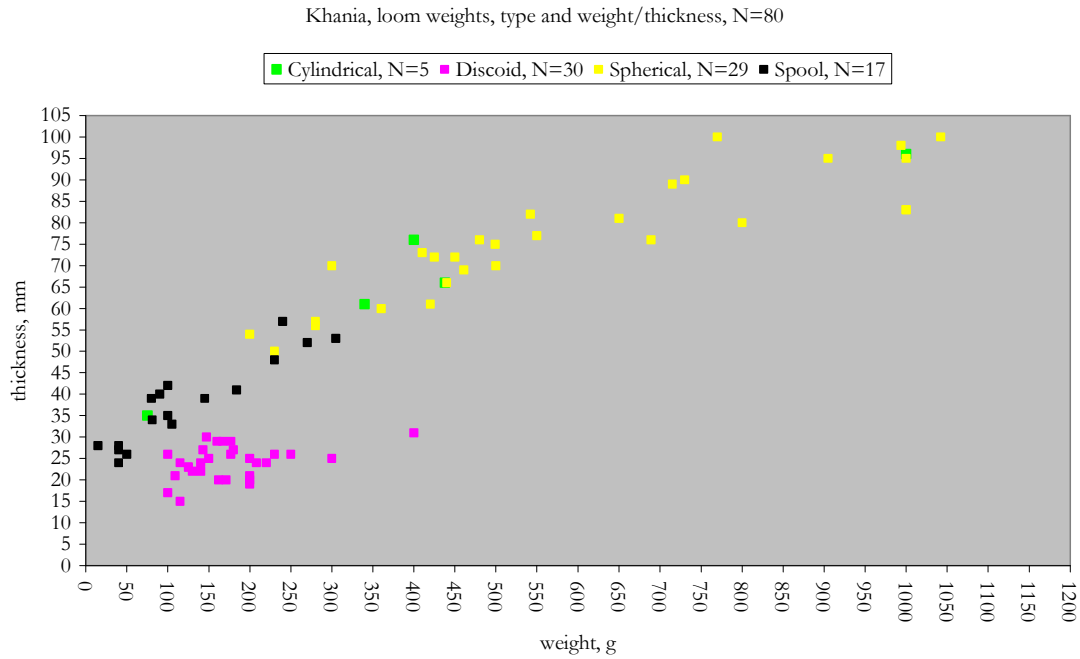


Figure 10. The relationship between type and weigh/thickness.

As can be seen in figure 10 there is a profound difference in weight/thickness between the types. The spherical loom weights vary in weight from 200g to 1042g and in thickness from 50 mm to 100 mm while the discoid loom weights vary in weight from 115g to 400g and in thickness from 15 mm to 31 mm. Finally, the spools vary in weight from 15g to 308g and in thickness from 24 mm to 53 mm.

To elucidate our interpretation of these loom weights and how the different variables affect a fabric we have calculated possible loom setups based on the loom weight measurements. We have chosen 3 spherical, 3 discoid and 3 spools (the lightest the heaviest and one in between). Please note, that these suggestions are based on our experience and experiments but are on the other hand conjectural as to what is optimal.

Loom weight KHA-82-TC 033 (spherical ovoid), weight 200g, thickness 54 mm				
	A	B	C	D
Warp threads requiring	10g warp tension	20g warp tension	30g warp tension	40g warp tension
Number of warp threads per loom weight	20	10	6-7	5
Number of warp threads per two loom weights (one in front layer, one in back layer)	40	20	12-14	10
Warp threads per cm	7-8	3-4	2-3	2
TTTC's evaluation of suitability of the tool	TTTC choice	Unlikely	Unlikely	Unlikely

Calculation of various loom setups with loom weight KHA-82-TC 033.

Loom weight KHA-77-TC 095 (spherical rounded), weight 542g, thickness 82 mm				
	A	B	C	D
Warp threads requiring	10g warp tension	20g warp tension	30g warp tension	40g warp tension
Number of warp threads per loom weight	54	27	18	13-14
Number of warp threads per two loom weights (one in front layer, one in back layer)	108	54	36	26-28
Warp threads per cm	13	6-7	4	3
TTTC's evaluation of suitability of the tool	Unlikely	TTTC choice	Possible	Unlikely

Calculation of various loom setups with loom weight KHA-77-TC 095.

Loom weight KHA-77-TC 080 (spherical rounded), weight 1042g, thickness 100 mm				
	A	B	C	D
Warp threads requiring	10g warp tension	20g warp tension	30g warp tension	40g warp tension
Number of warp threads per loom weight	104	52	34-35	26
Number of warp threads per two loom weights (one in front layer, one in back layer)	208	104	68-70	52
Warp threads per cm	21	10	7	5
TTTC's evaluation of suitability of the tool	Unlikely	Unlikely	Possible	TTTC choice

Calculation of various loom setups with loom weight KHA-77-TC 080

The calculations based on the spherical loom weights demonstrate that different types of fabrics could have been produced with this type of loom weight. The types of fabrics that could have been produced with KHA-82-TC 033 would be of fine quality with very thin threads, 6-7 threads/cm while KHA-77-TC 095 functions better with thin or thicker threads and 4-7 threads/cm. Loom weight KHA-77-TC 080 would function best when weaving a very coarse fabric with thicker threads and 5-7 threads/cm.

Loom weight KHA-80-TC 039 (discoid rounded), weight 115g, thickness 15 mm				
	A	B	C	D
Warp threads requiring	10g warp tension	20g warp tension	30g warp tension	40g warp tension
Number of warp threads per loom weight	11-12	6-7	4	3
Number of warp threads per two loom weights (one in front layer, one in back layer)	22-24	12-14	8	6
Warp threads per cm	15	8-9	5	4
TTTC's evaluation of suitability of the tool	TTTC choice	TTTC choice	Possible	Possible

Calculation of various loom setups with loom weight KHA-80-TC 039.

Loom weight KHA-87-TC 007 (discoid elliptical), weight 200g, thickness 20 mm				
	A	B	C	D
Warp threads requiring	10g warp tension	20g warp tension	30g warp tension	40g warp tension
Number of warp threads per loom weight	20	10	6-7	5
Number of warp threads per two loom weights (one in front layer, one in back layer)	40	20	12-14	10
Warp threads per cm	20	10	6-7	5
TTTC's evaluation of suitability of the tool	TTTC choice	TTTC choice	TTTC choice	TTTC choice

Calculation of various loom setups with loom weight KHA-87-TC 007.

Loom weight KHA-77-TC 086, (discoid elliptical), weight 400g, thickness 31 mm				
	A	B	C	D
Warp threads requiring	10g warp tension	20g warp tension	30g warp tension	40g warp tension
Number of warp threads per loom weight	40	20	13	10
Number of warp threads per two loom weights (one in front layer, one in back layer)	80	40	26	20
Warp threads per cm	26	13	8	6
TTTC's evaluation of suitability of the tool	Possible	TTTC choice	TTTC choice	TTTC choice

Calculation of various loom setups with loom weight KHA-77-TC 086.

The calculations based on the discoid loom weights demonstrate that many different types of fabrics with different types of threads could have been produced with this type of loom weight. With all three examples it is possible to produce coarse fabrics with thick or very thick threads but it is also possible to produce dense fabrics with many warp threads per centimetre: KHA-80-TC 039: 15 threads/cm, KHA-87-TC 007: 20 threads/cm and finally KHA-77-TC 086: 26 threads/cm. However, when weaving with a woollen thread it is preferable to not weave very dense fabrics. Because of the structure of the fibre, woollen threads have a tendency to get 'sticky' and thus the warp threads get caught in each other. The problem can, however, be avoided with linen fibres because these fibres have another structure and are longer. The problem can also be avoided be choosing another type of weave than tabby. In a tabby every second warp thread is lifted in the shed, whereas in a twill only every third or fourth thread is lifted at the same time. This means that the warp threads in a twill will not stick together as the warp threads in a tabby. Therefore the high thread density demonstrated by the loom setups calculated for the discoid loom weights could suggest that they were used for twill weaving.

Loom weight KHA-73-TC 006 (spool), weight 15g, thickness 28 mm				
	A	B	C	D
Warp threads requiring	10g warp tension	20g warp tension	30g warp tension	40g warp tension
Number of warp threads per loom weight	1-2			
Number of warp threads per two loom weights (one in front layer, one in back layer)	2-4			
Warp threads per cm	1			
TTTC's evaluation of suitability of the tool	Unlikely	Unlikely	Unlikely	Unlikely

Calculation of various loom setups with loom weight KHA-73-TC 006.

Loom weight KHA-77-TC 038 (spool), weight 105g, thickness 28 mm				
	A	B	C	D
Warp threads requiring	10g warp tension	20g warp tension	30g warp tension	40g warp tension
Number of warp threads per loom weight	10-11	5	3-4	2-3
Number of warp threads per two loom weights (one in front layer, one in back layer)	20-22	10	6-8	4-6
Warp threads per cm	7-8	3-4	2-3	1-2
TTTC's evaluation of suitability of the tool	TTTC choice	Unlikely	Unlikely	Unlikely

Calculation of various loom setups with loom weight KHA-77-TC 038.

Loom weight KHA-71-TC 114 (spool), weight 305g, thickness 53 mm				
	A	B	C	D
Warp threads requiring	10g warp tension	20g warp tension	30g warp tension	40g warp tension
Number of warp threads per loom weight	30-31	15	10	7-8
Number of warp threads per two loom weights (one in front layer, one in back layer)	60-62	30	20	14-16
Warp threads per cm	11-12	5-6	3-4	2-3
TTTC's evaluation of suitability of the tool	TTTC choice	TTTC choice	Unlikely	Unlikely

Calculation of various loom setups with loom weight KHA-71-TC 114.

The calculations demonstrate clearly that lighter spools are unlikely to be functional as loom weights in a warp weighted loom. Such a light weight would only give enough warp tension for very few threads and because of the thickness of the spools the fabric

would be too open. The lighter spools could instead have been used as weights for tablet weaving, braiding or warping. However, the TTTC weaving experiment with spools reconstructed from Khania have demonstrated that the heavier spools would function very well as loom weights for different types of fabrics (see Technical Report, Experimental Archaeology part 4). Using KHA-77-TC 038 it is possible to produce a fabric with very thin threads (7-8 threads/cm) and with KHA-71-TC 114 a fabric with 5-12 threads/cm.

Summary

Excluding the light spools, the three types of loom weights would function well as loom weights. The calculations demonstrate a wide variation of different types of fabrics. The calculations are based on a balanced fabric (please see introduction page 6) but the fabrics could also have been weft faced which results in a more dense fabric (figure 11). It is also very interesting to note the difference between the discoid and spherical loom weights. The analysis demonstrates that the discoid loom weights are suitable for weaving denser fabrics and could have been used for weaving twill. Furthermore, the discoid loom weights seem to be very flexible tools suitable for a range of qualities, whereas the spherical loom weights seem to be adapted to special qualities only.

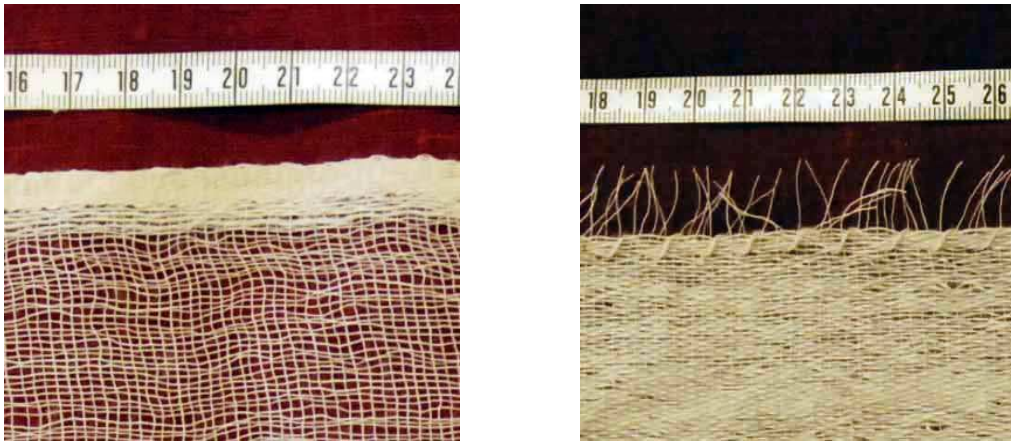


Figure 11. Two fabrics, both woven with threads requiring 10g warp tension. Left: a balanced tabby with app. 5 warp threads per cm and 8 weft threads per cm. Right: a weft faced tabby with app. 6 warp threads per cm and 15 weft threads per cm. (Mårtensson *et al.* 2007).

The development of weaving at Khania

As figure 12 shows, the loom weight sizes suggest a varied production of different types of fabrics during Neopalatial period. It should be noted that the majority of dated loom weights is from this period.. During LM II-LM IIIC the loom weights are in general lighter and thinner than the loom weights from earlier period, which suggests a greater emphasis on the finer qualities.

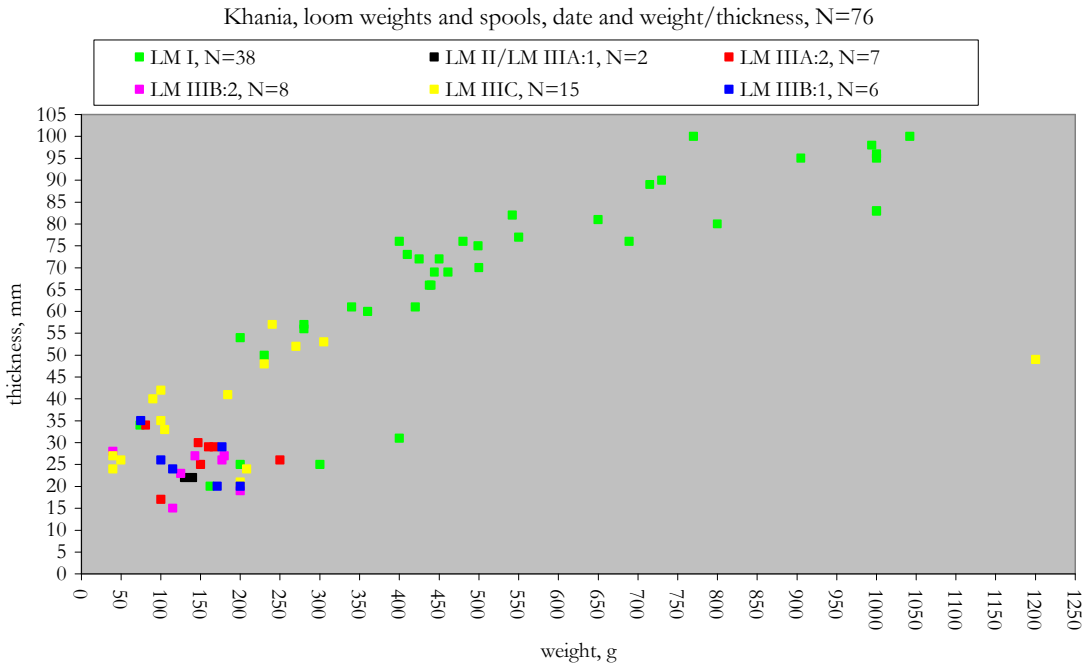


Figure 12. The relationship between the date and weight/thickness of the loom weights/spools.

Weaving at Khania during the LM I period

Fifty-four loom weights are from Neopalatial period and the majority derives from two LM 1 floor deposit contexts in House 1, Room E and Room M. The loom weights are in general spherical, but also six discoid and six cylindrical weights have been found (figure 9).

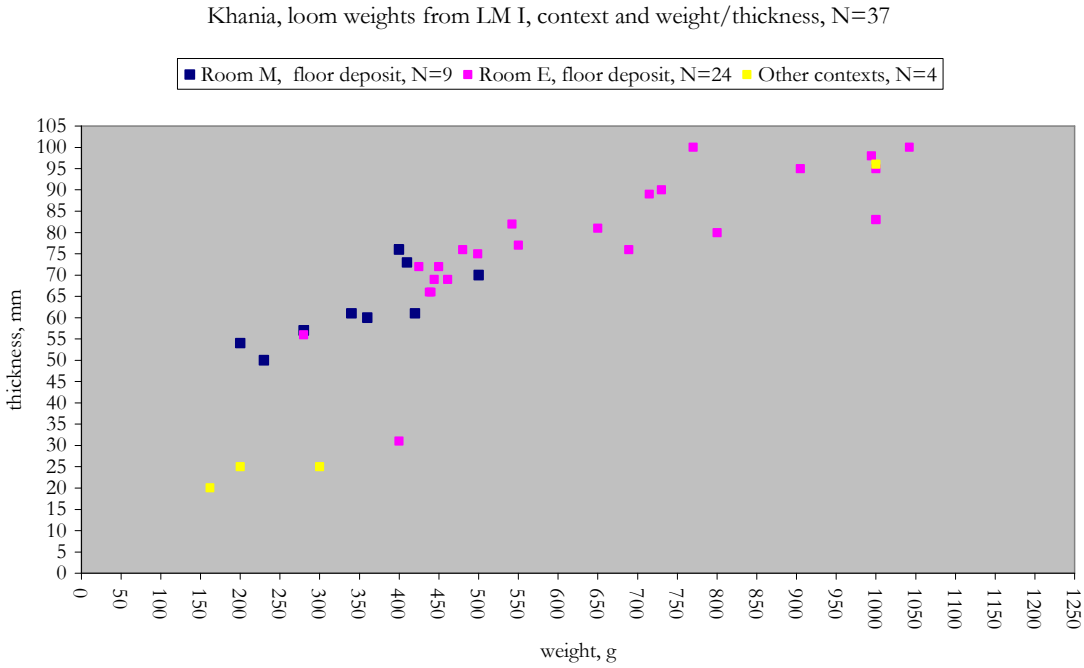


Figure 13. Loom weights from LM I in different contexts.

Room M

In Room M one loom weight was found in the north part of the room and 13 loom weights were found together with carbonized wood at the south-eastern part (Hallager, P. B. and Hallager, E forthcoming). Only 12 loom weights are indicated on the section drawing of the room, but the missing loom weight, KHA-82-TC 037, is included in GSE VI, p. 86 as 'loom weight 1'. This group of loom weights has been interpreted as the possible remains of a warp weighted loom. The weight and thickness have been estimated on nine loom weights. To elucidate our interpretation of these loom weights and how the different variables affect a fabric we have calculated possible loom setups based on the loom weight measurements.

Loom weight KHA-82-TC 029 (cylindrical standard): weight 400g, thickness 76 mm				
	A	B	C	D
Warp threads requiring	10g warp tension	20g warp tension	30g warp tension	40g warp tension
Number of warp threads per loom weight	40	20	13-14	10
Number of warp threads per two loom weights (one in front layer, one in back layer)	80	40	26-27	20
Warp threads per cm	10-11	5-6	3-4	2-3
TTTC's evaluation of suitability of the tool	Unlikely	TTTC choice	Unlikely	Unlikely

Calculation of various loom setups with loom weight KHA-82-TC 029.

Loom weight KHA-82-TC 030 (spherical ovoid): weight 280g, thickness 57 mm				
	A	B	C	D
Warp threads requiring	10g warp tension	20g warp tension	30g warp tension	40g warp tension
Number of warp threads per loom weight	28	14	9-10	7
Number of warp threads per two loom weights (one in front layer, one in back layer)	56	28	18-19	14
Warp threads per cm	9-10	5	3-4	2-3
TTTC's evaluation of suitability of the tool	TTTC choice	TTTC choice	Unlikely	Unlikely

Calculation of various loom setups with loom weight KHA-82-TC 030.

Loom weight KHA-82-TC 031 (spherical ovoid): weight 410g, thickness 73 mm				
	A	B	C	D
Warp threads requiring	10g warp tension	20g warp tension	30g warp tension	40g warp tension
Number of warp threads per loom weight	41	20-21	13-14	10
Number of warp threads per two loom weights (one in front layer, one in back layer)	82	41	27-28	20
Warp threads per cm	11-12	5-6	3-4	3
TTTC's evaluation of suitability of the tool	Unlikely	TTTC choice	Unlikely	Unlikely

Calculation of various loom setups with loom weight KHA-82-TC 031.

Loom weight KHA-82-TC 032 (spherical ovoid): weight 360g, thickness 60 mm				
	A	B	C	D
Warp threads requiring	10g warp tension	20g warp tension	30g warp tension	40g warp tension
Number of warp threads per loom weight	36	18	12	9
Number of warp threads per two loom weights (one in front layer, one in back layer)	72	36	24	18
Warp threads per cm	12	6	4	3
TTTC's evaluation of suitability of the tool	Possible	TTTC choice	Possible	Unlikely

Calculation of various loom setups with loom weight KHA-82-TC 032.

Loom weight KHA-82-TC 033 (spherical ovoid): weight 200g, thickness 54 mm				
	A	B	C	D
Warp threads requiring	10g warp tension	20g warp tension	30g warp tension	40g warp tension
Number of warp threads per loom weight	20	10	6-7	5
Number of warp threads per two loom weights (one in front layer, one in back layer)	40	20	13-14	10
Warp threads per cm	7-8	3-4	2-3	2
TTTC's evaluation of suitability of the tool	TTTC choice	Unlikely	Unlikely	Unlikely

Calculation of various loom setups with loom weight KHA-82-TC 033.

Loom weight KHA-82-TC 035 (spherical rounded): weight 500g, thickness 70 mm				
	A	B	C	D
Warp threads requiring	10g warp tension	20g warp tension	30g warp tension	40g warp tension
Number of warp threads per loom weight	50	25	16-17	12-13
Number of warp threads per two loom weights (one in front layer, one in back layer)	100	50	32-34	24-26
Warp threads per cm	14	7	4-5	3-4
TTTC's evaluation of suitability of the tool	Unlikely	TTTC choice	Possible	Unlikely

Calculation of various loom setups with loom weight KHA-82-TC 035.

Loom weight KHA-82-TC 036 (spherical rounded): weight 420g, thickness 61 mm				
	A	B	C	D
Warp threads requiring	10g warp tension	20g warp tension	30g warp tension	40g warp tension
Number of warp threads per loom weight	42	21	14	10-11
Number of warp threads per two loom weights (one in front layer, one in back layer)	84	42	28	20-22
Warp threads per cm	13-14	6-7	4-5	3
TTTC's evaluation of suitability of the tool	Unlikely	TTTC choice	Possible	Unlikely

Calculation of various loom setups with loom weight KHA-82-TC 036.

Loom weight KHA-82-TC 038 (cylindrical standard): weight 340g, thickness 61 mm				
	A	B	C	D
Warp threads requiring	10g warp tension	20g warp tension	30g warp tension	40g warp tension
Number of warp threads per loom weight	34	17	11-12	8-9
Number of warp threads per two loom weights (one in front layer, one in back layer)	68	34	22-23	16-18
Warp threads per cm	11	5-6	3-4	3
TTTC's evaluation of suitability of the tool	Possible	TTTC choice	Unlikely	Unlikely

Calculation of various loom setups with loom weight KHA-82-TC 038.

Loom weight KHA-82-TC 041 (spherical ovoid): weight 230g, thickness 50 mm				
	A	B	C	D
Warp threads requiring	10g warp tension	20g warp tension	30g warp tension	40g warp tension
Number of warp threads per loom weight	23	11-12	6-7	5-6
Number of warp threads per two loom weights (one in front layer, one in back layer)	46	22-24	12-14	10-12
Warp threads per cm	9	4-5	3	2
TTTC's evaluation of suitability of the tool	TTTC choice	Possible	Unlikely	Unlikely

Calculation of various loom setups with loom weight KHA-82-TC 041.

These calculations demonstrate that a warp thread requiring 20g tension would function on 8 of the weights, while a warp thread of 10g tension would be functional for KHA-82-TC 033. Please note that this does not exclude that KHA-82-TC 033 could be part of a loom setup with the other loom weights in the group. Rather, it is possible that the loom setup had a 15g warp tension, which would be functional for all the loom weights, or that the loom setup was just not optimal.

The 13 loom weights side by side in a row measure approximately 895 mm in thickness. Since a loom setup requires an even number of loom weights we might assume that 14 loom weights were used. The thickness of the loom weights side by side would thus have been approx. 1000 mm = 100 cm. On the loom, the loom weights would have been hanging in two rows, which signify that the fabric would have had a width of 50 cm.

We suggest the following loom setup:

Loom setup calculated on 20g warp tension with 6 threads per cm.

Starting border (width of the fabric): 50 cm

Number of loom weights needed: 14

Number of warp threads: 300 threads, 2 m each=600 m

Weft 1: if a balanced tabby = 600 m

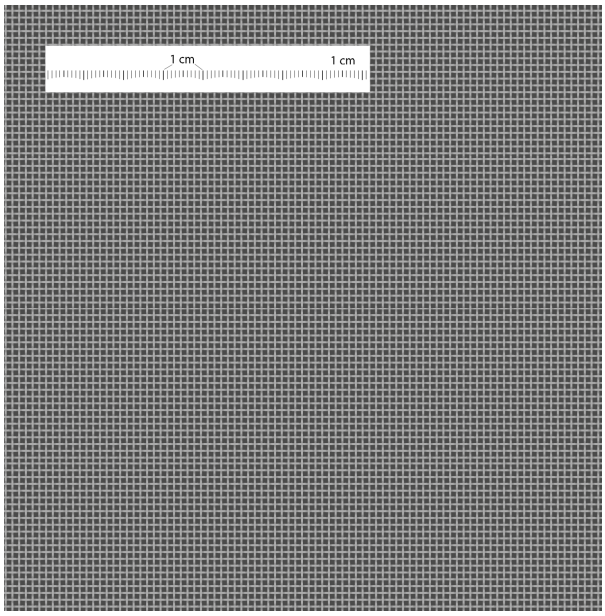
Weft 2: if a weft faced tabby = 1200 m

Total amount of yarn with weft 1 (+ 2%) = 1224 m

Total amount of yarn with weft 2 (+ 2%) = 1836 m

The calculations demonstrate that the amount of yarn needed is substantial. According to the TTTC experiments it would take approximately 30-45 hours to spin the thread needed to produce the fabric in this setup. Time for sorting and preparing the fibres is not included, neither is time for preparing the setup, weaving and finishing.

The fabric produced with this loom setup would have approximately 5-6 threads per centimetre in warp and, as can be seen in figure 14a, such a fabric would be, if woven as a balanced tabby, quite open. If the fabric was weft faced the fabric would be denser (figure 14b-c).



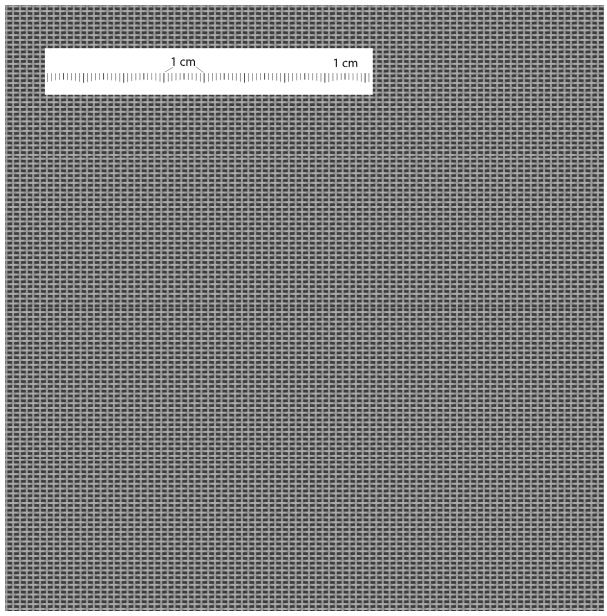


Figure 14a. **Left:** a balanced tabby with 0.5 mm thick threads and 5-6 threads per cm in warp and weft.
Figure 14b **Right:** a slightly weft faced tabby with 0.5 mm thick threads and 5-6 threads per cm in warp and 7.5 threads per cm in weft..

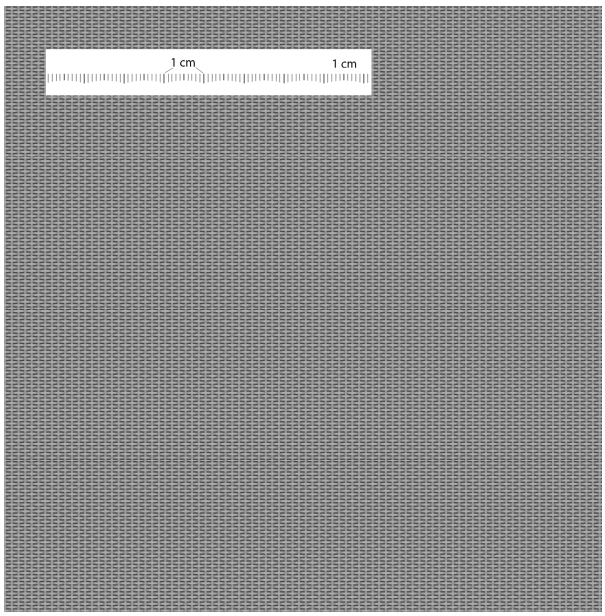


Figure 14c. A weft faced tabby with 0.5 mm thick threads and 5-6 threads per cm in warp and 10-12 threads per cm in weft.

Room E

No less than 38 loom weights were found in room E and we have recorded 32 in the TTTC database. As can be seen in figure 13 the weight varies from 280g to 1042g and the thickness from 31mm to 100mm. The fabrics that may have been produced with

these loom weights would be of different types. We have calculated the possible loom setups for two of these loom weights.

Loom weight KHA-77-TC 102: weight 650g, thickness 81mm				
	A	B	C	D
Warp threads requiring	10g warp tension	20g warp tension	30g warp tension	40g warp tension
Number of warp threads per loom weight	65	32-33	21	16
Number of warp threads per two loom weights (one in front layer, one in back layer)	130	64-66	42	32
Warp threads per cm	16	8	5	4
TTTC's evaluation of suitability of the tool	Unlikely	Possible	TTTC choice	Possible

Calculation of various loom setups with loom weight KHA-77-TC 102

The calculation demonstrates that loom weight KHA-77-TC-102 would function well with a warp thread requiring approximately 30g warp tension (C). The fabric produced with this setup C would have 5 threads per cm in warp and 5 threads or more per cm in weft. The type of fabric that would have been produced with this loom weight (choice C) would be coarse with thick threads (figure 15).

For TTTC choice C we suggest the following loom setup:

Loom setup calculated on 30g warp tension (C)

Starting border (width of the fabric): 50 cm

Number of loom weights needed: 12

Number of warp threads: 250 threads, 2 m each=500 m

Weft 1: if a balanced tabby = 500 m

Weft 2: if a weft faced tabby = 1000 m

Total amount of yarn with weft 1 (+ 2%) = 1020 m

Total amount of yarn with weft 2 (+ 2%) = 1530 m

The calculations demonstrate that the amount of yarn needed is substantial. According to the TTTC experiments it would take approximately 20-31 hours to spin the thread needed to produce the fabric in this setup.

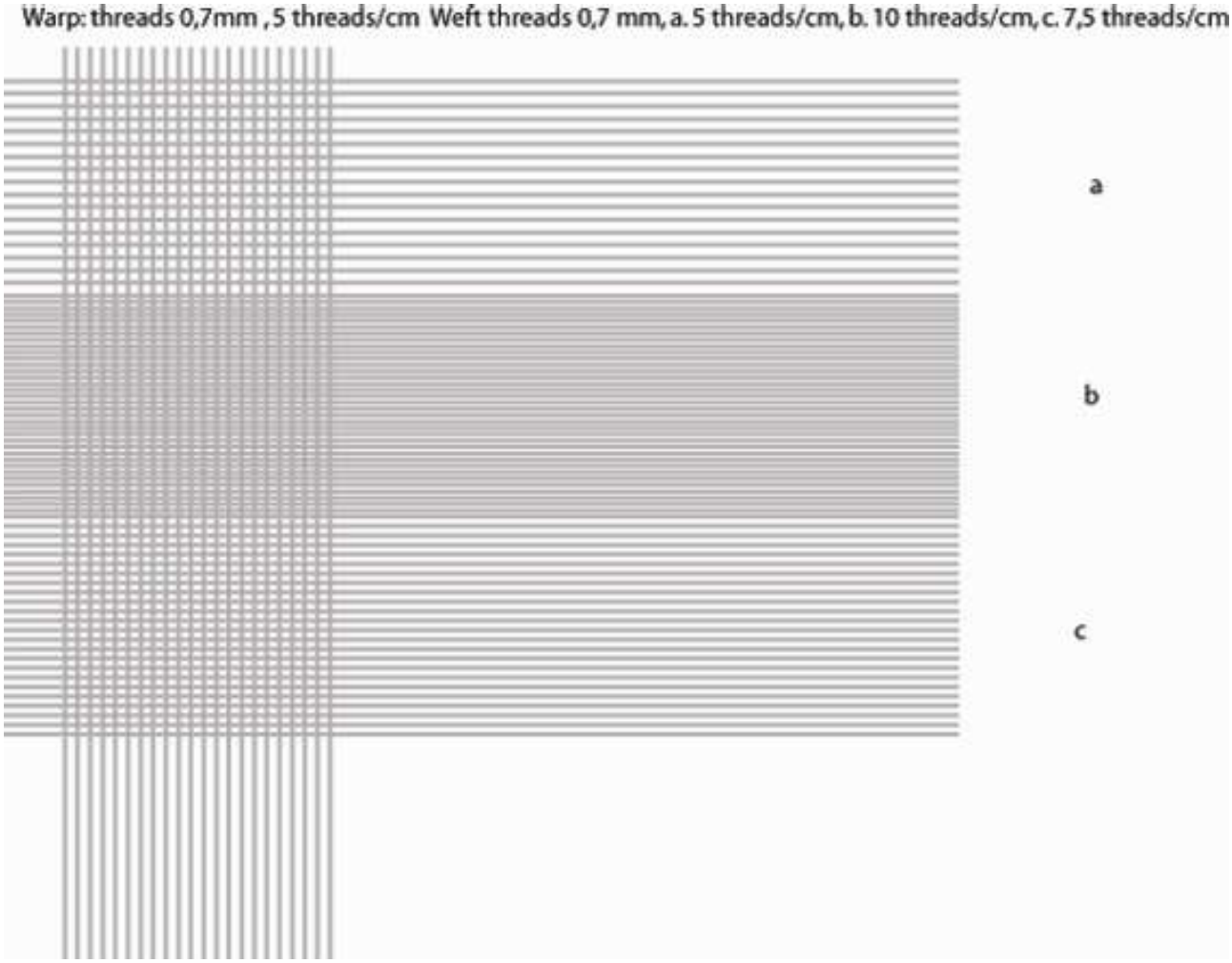


Figure 15: Fabrics that could have been produced with KHA-77-TC 102.

Loom weight KHA-77-TC 080: weight 1042 g, thickness 100 mm				
	A	B	C	D
Warp threads requiring	10g warp tension	20g warp tension	30g warp tension	40g warp tension
Number of warp threads per loom weight	104	52	34	26
Number of warp threads per two loom weights (one in front layer, one in back layer)	208	104	68	52
Warp threads per cm	20	10	7	5
TTTC's evaluation of suitability of the tool	Unlikely	Unlikely	Possible	TTTC choice

Calculation of various loom setups with loom weight KHA-77-TC 080

The calculation demonstrates that loom weight KHA-77-TC-080 would function well with a warp thread requiring roughly 40g warp tension (D). The fabric produced with this setup C would have 5 threads per cm in warp and 5 threads or more per cm in weft. The type of fabric that could have been produced with this loom weight (choice D) would be very coarse with very thick threads (figure 16).

For TTTC choice D we suggest the following loom setup:

Loom setup calculated on 40g warp tension (D)

Starting border (width of the fabric): 50 cm

Number of loom weights needed: 10

Number of warp threads: 250 threads, 2 m each=500 m

Weft 1: if a balanced tabby = 500 m

Weft 2: if a weft faced tabby = 1000 m

Total amount of yarn with weft 1 (+ 2%) = 1020 m

Total amount of yarn with weft 2 (+ 2%) = 1530 m

The calculations demonstrate that the amount of yarn needed is substantial. According to the TTTC experiments it would take approximately 20-31 hours to spin the thread needed to produce the fabric in this setup.

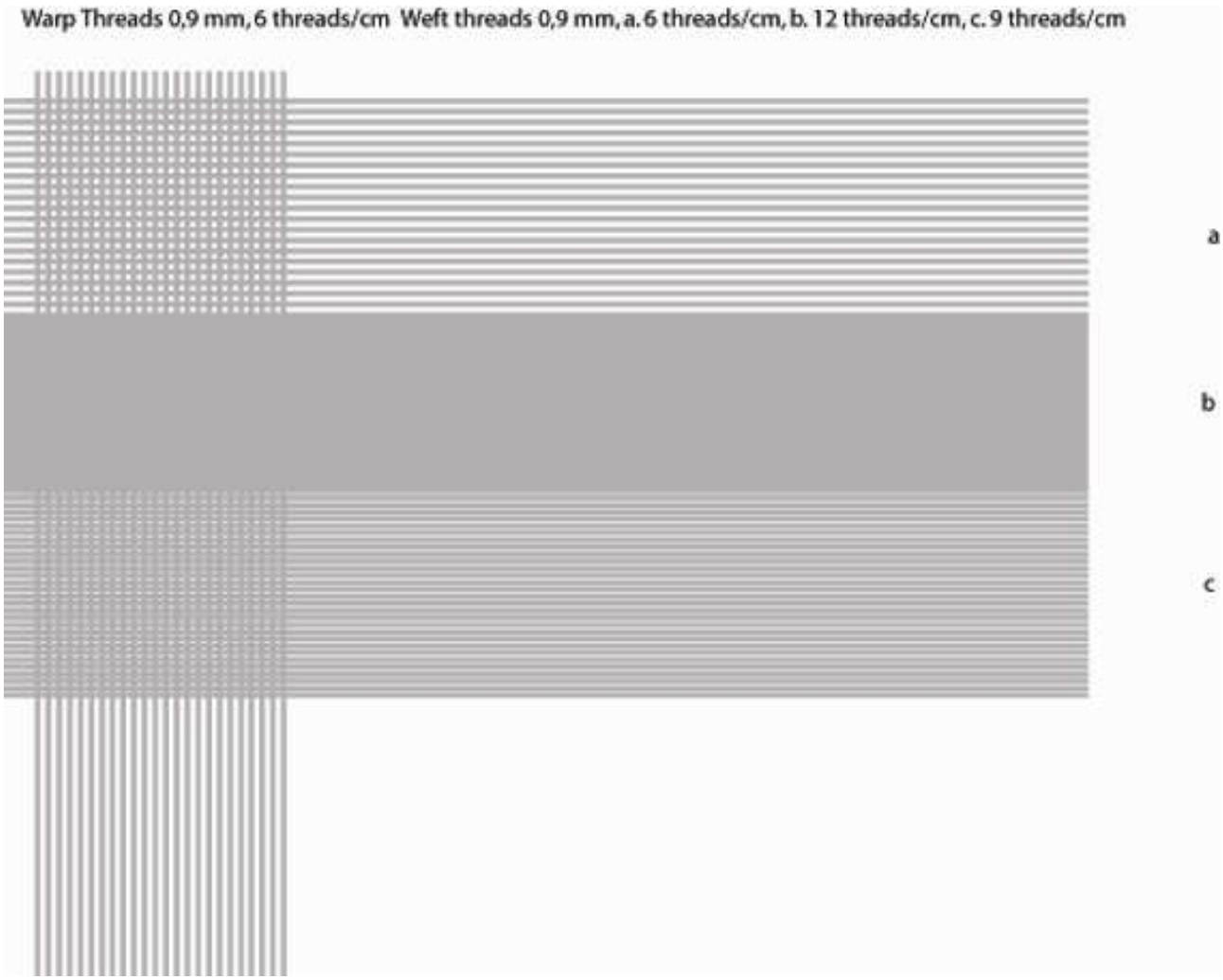


Figure 16: Fabrics that may have been produced with KHA-77-TC 080.

Summary LM I

The analyses suggest a varied production of fabric qualities, both fine and coarse woven with very thin to very thick threads. The fabrics may have been both open and dense. The number of loom weights deriving from room E is interesting and this room functioned as a store room (Hallager B. P. & Hallager E Vol VI forthcoming). If also loom weights were stored in this room this could elucidate the large variation in the loom weights' size (figure 13) and indicate that different types and sizes of loom weight were used for different types of loom set ups.

The finds from room M, floor deposit, indicate a multiple function of this room. The loom was standing in the south-eastern part of the room in a right angle to the north wall *c* one metre away from the east wall where a window may have been placed. (Hallager B. P. & Hallager E Vol VI forthcoming). If so, the light would be excellent for weaving. Interesting, there is no indication of the loom leaning on a wall which is usually suggested when using this type of loom. If the loom was standing straight up the so called natural shed could not have been used. This indicates a different type of set up than usually suggested. However, there may have been applied some type of construction that made it is possible to lean the loom.

Weaving at Khania in the LM IIIA:2 period

Six loom weights and one spool derive from LM IIIA:2. All the loom weights are discoid in shape. The weight of the objects varies from 81g to 250g and the thickness from 17 mm to 34 mm. Five are from pits of which three are from the same pit in space E .None derive from floor deposits. To elucidate our interpretation of these loom weights and how the different variables affect a fabric we have calculated possible loom setups based on the measurements of two of the loom weights from LM IIIA:2.

Loom weight: KHA-84-TC 018: weight 160g, thickness 29 mm				
	A	B	C	D
Warp threads requiring	10g warp tension	20g warp tension	30g warp tension	40g warp tension
Number of warp threads per loom weight	16	8	5	4
Number of warp threads per two loom weights (one in front layer, one in back layer)	32	16	10	8
Warp threads per cm	11	5	3	3
TTTC's evaluation of suitability of the tool	TTTC choice	TTTC choice	Unlikely	Unlikely

Calculation of various loom setups with loom weight KHA-84-TC 018

The calculation demonstrates that loom weight KHA-84-TC 018 would function both with a warp thread requiring 10g warp tension (A) and a warp thread of 20g tension (B). The fabric produced with loom setup A would have 11 threads per cm in warp and the fabric produced with loom setup B would have 5 threads per cm in warp.

The types of fabrics that could have been produced with this loom weight (choice A and B) would be of fine quality with very thin or thin threads. However, the fabrics would be visually different.

For TTTC choice A we suggest the following loom setup:

Loom setup calculated on 10g warp tension (A)

Starting border (width of the fabric): 50 cm

Number of loom weights needed: 34

Number of warp threads: 550 threads, 2 m each=1100 m

Weft 1: if a balanced tabby = 1100 m

Weft 2: if a weft faced tabby = 2200 m

Total amount of yarn with weft 1 (+ 2%) = 2244 m

Total amount of yarn with weft 2 (+ 2%) = 3366 m

The calculations demonstrate that the amount of yarn needed is substantial. According to the TTTC experiments it would take approximately 64-96 hours to spin the thread needed to produce the fabric in this setup. (Time for sorting and preparing the fibres is not included, neither is time for preparing the setup, weaving and finishing.)

Loom weight KHA-71-TC 037: weight 250g, thickness 26 mm				
	A	B	C	D
Warp threads requiring	10g warp tension	20g warp tension	30g warp tension	40g warp tension
Number of warp threads per loom weight	25	12-13	8	6
Number of warp threads per two loom weights (one in front layer, one in back layer)	50	24-26	16	12
Warp threads per cm	19	9-10	6	4-5
TTTC's evaluation of suitability of the tool	TTTC choice	TTTC choice	TTTC choice	Possible

Calculation of various loom setups with loom weight KHA-71-TC 037.

The calculations based on loom weight KH-71-TC 037 demonstrate that many different types of fabrics with different types of threads could have been produced with this tool . With this type of loom weight it is possible to produce dense fabrics with many threads per centimetre. Furthermore KHA-71-TC 037 would function very well if producing a twill weave.

For TTTC choice A we suggest the following loom setup:

Loom setup calculated on 10g warp tension (A)

Starting border (width of the fabric): 50 cm

Number of loom weights needed: 38

Number of warp threads: 950 threads, 2 m each=1900 m

Weft 1: if a balanced tabby = 1900 m

Weft 2: if a weft faced tabby = 3800 m

Total amount of yarn with weft 1 (+ 2%) =3876 m

Total amount of yarn with weft 2 (+ 2%) = 5814 m

The calculations demonstrate that the amount of yarn needed is substantial. According to the TTTC experiments it would take approximately 110-166 hours to spin the thread needed to produce the fabric in this setup.

.

Summary

The number of loom weights from LM IIIA:2 is small and can not be considered as representative for this period. However, the six loom weights indicate a production of quite dense fabrics with thin or very thin threads. The number of loom weights needed for the calculated set ups is substantial. To produce coarser fabrics with thicker threads it would be easier and more economical to use heavier and thicker loom weights

Weaving at Khania during the LM IIIB:1 period

Sixteen loom weights have been recorded from LM IIIB:1. They derive from different contexts and only one weight is from floor deposit. Nine loom weights are a discoid. One loom weight (KHA-73-TC 023) is cylindrical and quite small (weight 46g thickness 36 mm) This weight would not have been functional as a loom weight in a warp weighted loom(see p. 10). Another cylindrical weight KHA-71-TC 021 (weight 75g, thickness 35mm) may have been used but the fabric would be very open.

One cylindrical stone weight (KHA-77-S 042) may have functioned as a loom weight. Its weight (505g) indicates that a fabric produced with this weight would be coarse and with thick threads.

Furthermore, in space G (floor deposit) were "11 stones lying on an almost straight row in a length of c. 0.75 and of almost equal size. The very tempting interpretation of these finds is that a small loom had been standing up against the wall in this area. None of the stones, alas, were collected" (Hallager B. P. and Hallager, E vol IV forthcoming). It is not possible to estimate the size or weight of the stone weights but the interpretation that this could have been the place for a warp weighted loom is likely. Interesting is also that four discoid loom weights (KHA-87-TC 004, KHA-87-TC 007, KHA-87-TC 011 and KHA-87-TC 015) and one KS whorl have derived from the same room. Two of the loom weights are from a pit and two derive from levelling deposits. Unfortunate three of these loom weights are fragmentary and it is not possible to estimate their weight.

The LM IIIB:1 loom weight varies from 75g to 200g and the thickness from 20 mm to 35 mm. To elucidate our interpretation of these loom weights and how the different variables affect a fabric we have calculated possible loom setups based on the measurements of two of the loom weights from LM IIIB:1.

Loom weight KHA-87-TC 007: weight 200 g, thickness 20 mm				
	A	B	C	D
Warp threads requiring	10g warp tension	20g warp tension	30g warp tension	40g warp tension
Number of warp threads per loom weight	20	10	6-7	5
Number of warp threads per two loom weights (one in front layer, one in back layer)	40	20	12-14	10
Warp threads per cm	20	10	6-7	5
TTTC's evaluation of suitability of the tool	TTTC choice	TTTC choice	TTTC choice	TTTC choice

Calculation of various loom setups with loom weight KHA-87-TC 007. Please note that this is one of the loom weights from Building 1, space G.

The calculations based on loom weight KH-87-TC 007 demonstrate that many different types of fabrics with different types of threads may have been produced with this tool. With this type of loom weight is it possible to produce dense fabrics with many threads per centimetre, but also coarse fabrics with very thick threads. However it is more realistic that it was used when weaving finer and denser fabrics. Furthermore KHA-71-TC 037 would function very well if weaving a twill.

For TTTC choice B we suggest the following loom setup:

Loom setup calculated on 20g warp tension (B)

Starting border (width of the fabric): 50 cm

Number of loom weights needed: 50

Number of warp threads: 1000 threads, 2 m each=2000 m

Weft 1: if a balanced tabby = 2000 m

Weft 2: if a weft faced tabby = 4000 m

Total amount of yarn with weft 1 (+ 2%) =4080 m

Total amount of yarn with weft 2 (+ 2%) = 6120 m

The calculations demonstrate that the amount of yarn needed is substantial. According to the TTTC experiments it would take approximately 102-153 hours to spin the thread needed to produce the fabric in this setup.

Loom weight KHA-82-TC 004: weight 177g, thickness 29 mm				
	A	B	C	D
Warp threads requiring	10g warp tension	20g warp tension	30g warp tension	40g warp tension
Number of warp threads per loom weight	17-18	9	6	4
Number of warp threads per two loom weights (one in front layer, one in back layer)	34-36	18	12	8
Warp threads per cm	12	6	4	3
TTTC's evaluation of suitability of the tool	TTTC choice	TTTC choice	Possible	Unlikely

Calculation of various loom setups with loom weight KHA-82-TC 004.

The calculation demonstrates that loom weight KHA-82-TC 004 would function both with a warp thread requiring 10g warp tension (A) and a warp thread of 20g tension (B). The fabric produced with loom setup A would have 12 threads per cm in warp and 12 threads in weft or more per cm. The fabric produced with loom setup B would have 6 threads per cm in warp and weft, but if weft faced 12 threads per cm in weft

The types of fabrics that could have been produced with this loom weight (choice A and B) would be of fine quality with very thin or thin threads. However, the fabrics would be visually different.

For TTTC choice B we suggest the following loom setup:

Loom setup calculated on 20g warp tension (B)

Starting border (width of the fabric): 50 cm

Number of loom weights needed: 34

Number of warp threads: 300 threads, 2 m each=600 m

Weft 1: if a balanced tabby = 600 m

Weft 2: if a weft faced tabby = 1200 m

Total amount of yarn with weft 1 (+ 2%) =1224 m

Total amount of yarn with weft 2 (+ 2%) = 1836 m

The calculations demonstrate that the amount of yarn needed is substantial. According to the TTTC experiments it would take approximately 30-46 hours to spin the thread needed to produce the fabric in this setup.

Summary

The LM IIIB:1 discoid shaped loom weights indicate a varied production of different types of fabrics with primarily thin or very thin threads. The number of loom weights needed for the calculated set ups is however substantial. To produce coarser fabrics with thicker threads it would be easier and more economical to use heavier and thicker loom weights. It is possible that stone weights could have been used for this production.

Weaving at Khania during the LM IIIB:2 period

Thirteen loom weights, of which 11 have a discoid shape and four spools from LM IIIB:2 are recorded in the database. The weight of the loom weights varies from 115g to 200g and their thickness from 15 mm to 27 mm. KHA-80-TC 034 a spool (weight 40g thickness 36 mm), cannot have been functional as a loom weight (see page 10).

The weights are in general from pits (eight loom weights and one spool) and only one spool derives from a floor deposit. To elucidate our interpretation of these loom weights and how the different variables affect a fabric we have calculated possible loom setups based on the measurements of KHA-80-TC 039 and KHA-77-TC 033.

Loom weight KHA-80-TC 039: weight 115g, thickness 15 mm				
	A	B	C	D
Warp threads requiring	10g warp tension	20g warp tension	30g warp tension	40g warp tension
Number of warp threads per loom weight	11-12	6	4	3
Number of warp threads per two loom weights (one in front layer, one in back layer)	22-24	12	8	6
Warp threads per cm	15	8	5	4
TTTC's evaluation of suitability of the tool	TTTC choice	TTTC choice	TTTC choice	Possible

Calculation of various loom setups with loom weight KHA-80-TC 039.

The calculations based on loom weight KH-80-TC 039 demonstrates that many different types of fabrics with different types of threads may have been produced with this loom weight. With this type of loom weight is it possible to produce dense fabrics with many threads per centimetre but also coarse fabrics with very thick threads. However, it is more realistic that this type of loom weight was used when weaving finer and denser fabrics. Furthermore KHA-80-TC 039 would function very well if weaving twill.

For TTTC choice B we suggest the following loom setup:

Loom setup calculated on 20g warp tension (B)

Starting border (width of the fabric): 50 cm

Number of loom weights needed: 66

Number of warp threads: 400 threads, 2 m each=800 m

Weft 1: if a balanced tabby = 800 m

Weft 2: if a weft faced tabby = 1600 m

Total amount of yarn with weft 1 (+ 2%) =1632 m

Total amount of yarn with weft 2 (+ 2%) = 2448 m

The calculations demonstrate that the amount of yarn needed is substantial. According to the TTTC experiments it would take approximately 41-61 hours to spin the thread needed to produce the fabric in this setup.

Loom weight KHA-77-TC 033: weight 200g, thickness 19 mm				
	A	B	C	D
Warp threads requiring	10g warp tension	20g warp tension	30g warp tension	40g warp tension
Number of warp threads per loom weight	20	10	6-7	5
Number of warp threads per two loom weights (one in front layer, one in back layer)	40	20	12-14	10
Warp threads per cm	21	10-11	7	5
TTTC's evaluation of suitability of the tool	TTTC choice	TTTC choice	TTTC choice	TTTC choice

Calculation of various loom setups with loom weight KHA-77-TC 033.

The calculations based on loom weight KH-77-TC 033 demonstrates that many different types of fabrics with different types of threads could have been produced with this of loom weight. With this type of loom weight is it possible to produce dense fabrics with many threads per centimetre but also coarse fabrics with very thick threads. However, it is more realistic that this type of loom weight was used when weaving finer and denser fabrics. Furthermore KHA-77-TC 033 would function very well if weaving twill.

For TTTC choice A we suggest the following loom setup:

Loom setup calculated on 10g warp tension (B)

Starting border (width of the fabric): 50 cm

Number of loom weights needed: 50

Number of warp threads: 1050 threads, 2 m each=2100 m

Weft 1: if a balanced tabby = 2100 m

Weft 2: if a weft faced tabby = 4200 m

Total amount of yarn with weft 1 (+ 2%) =4284 m

Total amount of yarn with weft 2 (+ 2%) = 6426 m

The calculations demonstrate that the amount of yarn needed is substantial. According to the TTTC experiments it would take approximately 122-184 hours to spin the thread needed to produce the fabric in this setup.

Summary

The LM IIIB:2 discoid shaped loom weights indicate a varied production of different types of fabrics with primarily thin or very thin threads. The number of loom weights

needed for the calculated set ups is however substantial. To produce coarser fabrics with thicker threads it would be easier and more economical to use heavier and thicker loom weights.

Weaving at Khania during the LM IIIC period

Eighteen spools and seven loom weights (five discoid and two torus shaped) are from LM IIIC. The weights are from different contexts, whereas the 11 spools are from the same pit (Building 1, room I).

The spools vary in weight from 40g to 305g and in thickness from 24 mm to 54 mm. As was demonstrated above for KHA-73-TC 006 (p. 10) the lightest spools from Khania are not functional on the warp weighted loom. Three LM IIIC spools, all from the pit in room I, (KHA-71-TC 108, KHA-71-TC 107, KHA-71-TC 109) have therefore been excluded from the analysis.

To elucidate our interpretation of the LM IIIC loom weights and how the different variables affect a fabric we have calculated possible loom setups based on the measurements of two of the loom weights from LM IIIC.

Loom weight: KHA-84-TC 011 weight 240g, thickness 57mm				
	A	B	C	D
Warp threads requiring	10g warp tension	20g warp tension	30g warp tension	40g warp tension
Number of warp threads per loom weight	24	12	8	6
Number of warp threads per two loom weights (one in front layer, one in back layer)	48	24	16	12
Warp threads per cm	8	4	3	2
TTTC's evaluation of suitability of the tool	TTTC choice	Possible	Unlikely	Unlikely

Calculation of various loom setups with loom weight: KHA-84-TC 011.

The calculation demonstrates that loom weight KHA-84-TC 011 would function well with a warp thread requiring 10g warp. The fabric produced with loom setup A would have 8 threads per cm in warp and 8 threads in weft or more per cm. This type of fabric would be of fine quality with very thin and, if not weft faced, quite open.

For TTTC choice A we suggest the following loom setup:

Loom setup calculated on 10g warp tension (A)

Starting border (width of the fabric): 50 cm

Number of loom weights needed: 18

Number of warp threads: 400 threads, 2 m each=800 m

Weft 1: if a balanced tabby = 800 m

Weft 2: if a weft faced tabby = 1600 m

Total amount of yarn with weft 1 (+ 2%) =1632 m

Total amount of yarn with weft 2 (+ 2%) = 2448 m

The calculations demonstrate that the amount of yarn needed is substantial. According to the TTTC experiments it would take approximately 41-61 hours to spin the thread needed to produce the fabric in this setup.

Loom weight KHA-77-TC 029: weight 208g, thickness 24 mm				
	A	B	C	D
Warp threads requiring	10g warp tension	20g warp tension	30g warp tension	40g warp tension
Number of warp threads per loom weight	21	10-11	7	5
Number of warp threads per two loom weights (one in front layer, one in back layer)	42	20-22	14	10
Warp threads per cm	17-18	9	6	4
TTTC's evaluation of suitability of the tool	TTTC choice	TTTC choice	TTTC choice	Possible

Calculation of various loom setups with loom weight KHA-77-TC 029.

The calculations based on loom weight KH-77-TC 029 demonstrates that many different types of fabrics with different types of threads could have been produced with this of loom weight. With this type of loom weight is it possible to produce dense fabrics with many threads per centimetre but also coarse fabrics with very thick threads. However, it is more realistic that this type of loom weight has been used when weaving finer and denser fabrics. Furthermore KHA-77-TC 029 would function very well if weaving twill.

For TTTC choice A we suggest the following loom setup:

Loom setup calculated on 10g warp tension

Starting border (width of the fabric): 50 cm

Number of loom weights needed: 42

Number of warp threads: 850 threads, 2 m each=1700 m

Weft 1: if a balanced tabby = 1700 m

Weft 2: if a weft faced tabby = 3400 m

Total amount of yarn with weft 1 (+ 2%) = 3468 m

Total amount of yarn with weft 2 (+ 2%) = 5202 m

The calculations demonstrate that the amount of yarn needed is substantial. According to the TTTC experiments it would take approximately 100-148 hours to spin the thread needed to produce the fabric in this setup..

Furthermore two weaving experiments has been carried out on the bases of two different spools, KHA-71-TC 106 and KHA-71-TC 115, from LM IIIC (Building 1 room I, pit deposit) (see Mårtensson et al technical Report Experimental Archaeology Part 4 spools 2007) (figure 17).

The experiments confirmed that larger spools are suitable for weaving but also that the fabrics would become open (figure 18-20). Most likely these fabrics were more or less weft faced.

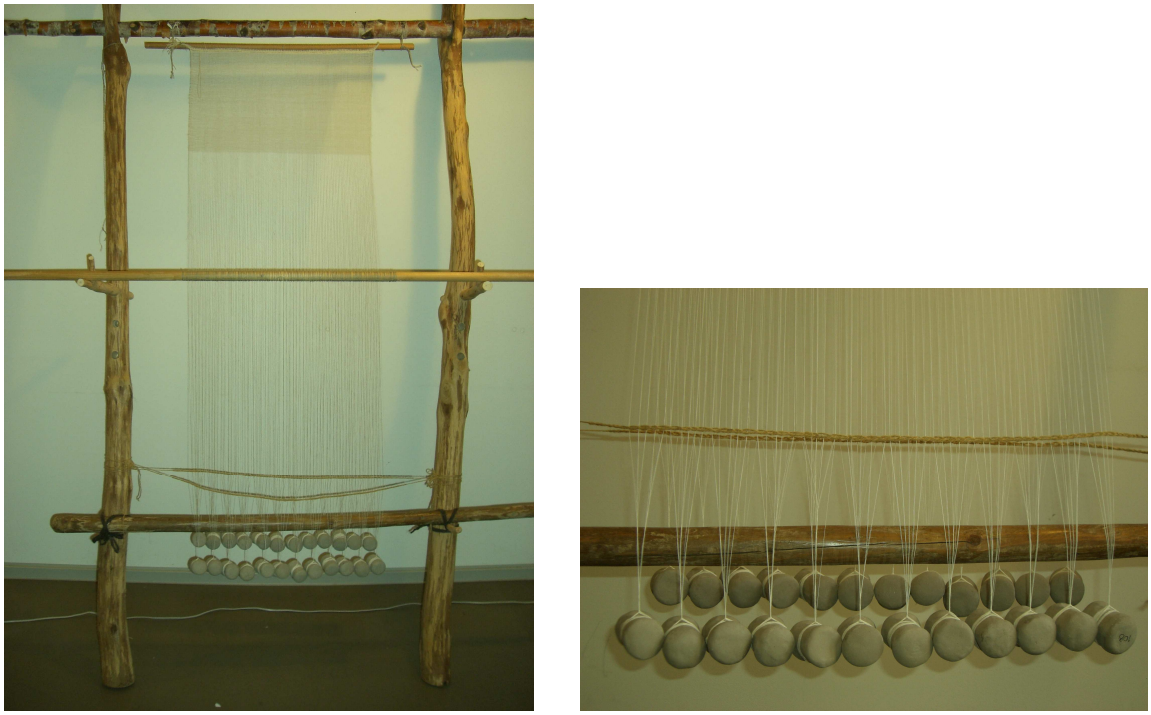


Figure 17. Weaving in progress, the spools are reconstructed on the bases of KHA-71-TC 106.

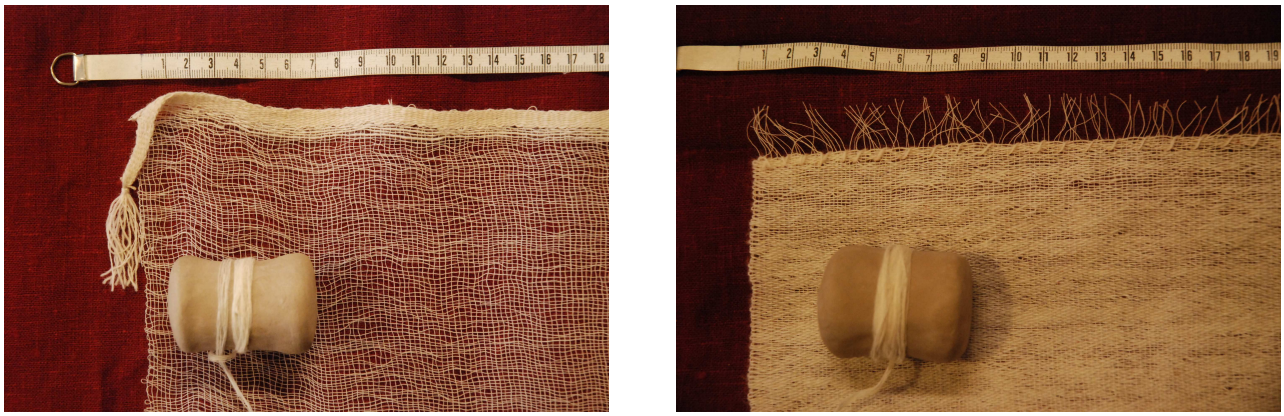


Figure 18. **Left**: 5 threads in warp and 8 threads in weft per centimetre warp thread tension 10g.
Right 6 threads in warp and 15 in weft per centimetre, warp thread tension 10g.
The spools are reconstructed on the bases of KHA-71-TC 106.

Figure 19 **Left**: 6 threads in warp and 7 threads in weft per centimetre, thread tension 20g. The spool is reconstructed on the bases of KHA-71-TC 115. **Right:** 6 threads in warp and 8 threads in weft per centimetre, thread tension 10g. The spool is reconstructed on the bases of KHA-71-TC 106.

Figure 20 **Left:** Six threads in warp and seven threads in weft per centimetre, thread tension 20g. The spool is reconstructed on the bases of KHA-71-TC 115. **Right:** five threads in warp and eight in weft per centimetre, thread tension 10g. Right five threads in warp and 15 in weft per centimetre, thread tension 10g. The spools are reconstructed on the bases of KHA-71-TC 106.

Summary

The LM IIIC loom weights, both the discoid shaped weights and the spools, indicate a varied production of different types of fabrics with primarily thin or very thin threads. However, the fabrics would be visually different depending on which type of loom weights that were used. However there are no loom weights that are suitable for producing coarser fabrics with thicker threads

OTHER TEXTILE TOOLS

A few 'other textile tools', pins, pin beaters and needles were also recorded in the database, but because of their scantiness and fragmentary state it has not been possible to draw any conclusions on the basis of this material (figure 3). However it is most likely that the textile workers have been using different types of weaving beaters, spindle shafts, pin beaters (a multifunctional weaving tool). The analyses of the spindle whorls and loom weights indicate a production of fine types of fabrics with very thin threads. To prepare the fibres for this production they would for example have used wool combs. Sewing in fine cloth demands very thin needles which also may have been made in bone.

TEXTILE PRODUCTION IN KHANIA

Only one spindle whorl is dated to the LM I and thus on the basis of this tool we cannot reach any conclusions regarding the textile production. The analysis of the loom weights deriving from LM I, however, suggest a varied production of fabric qualities. A large number of spherical loom weights with a very wide range of possible fabric qualities derive from this period. A few discoid loom weights also deriving from the period may also be used for denser fabrics. A group of LM I loom weights found together in room M, house I may be part of the remains of a warp weighted loom. We have calculated loom setups for nine of these weights and we conclude that, although it would not be an optimal loom setup, it is indeed possible that the loom weights and the charred wood found in room M constitute the remains of a warp weighted loom.

Thus, the tools deriving from LM I do not suggest a specialised production, but rather a very broad range of qualities, perhaps with an emphasis on open weaves.

A number of spools derive from the LM III. Our calculations suggest that the smallest of these could *not* be used as loom weights on a warp weighted loom. It is possible that they were used as other textile tools, such as for braiding, warping or tablet weaving.

The loom weights from this period seem quite specialised for finer fabrics. Some weights may also have been used for weaving coarser qualities, however, these loom setups demand a very large number of loom weights with only few warp threads attached to each of them. To weave coarser fabrics it would be much easier and more economical to use heavier and thicker loom weights that would produce such fabrics with much fewer loom weights. This suggests that the loom weights were used primarily for finer fabrics in the LM III. The spindle whorls from the period support this

conclusion. Although it is clear that the excavated material is not fully representative for the entire range of production, the analysis of the spindle whorls shows a very strong emphasis on the production of fine and very fine threads. It is likely that Khania also had a production of coarse fabrics, e.g. for sails, but such a production is not represented in the material.

The analysis of the discoid loom weights has yielded interesting results. The weight of the loom weights is quite low and they are rather slim resulting in a very high thread density. If the primary fibre of Khania was wool, it is likely that these discoid loom weights were not used for tabby weaving, but were specialised textile tools used for twill weaving.