Indian Journal of Fibre & Textile Research
Vol. 40, December 2015, pp. 356-362

Weaving twill damask fabric using ‘section- scale- stitch’ harnessing

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Received 6 June 2014; revised received and accepted 30 July 2014

The possibility of weaving figured twill damask using the combination of ‘sectional-scaled- stitched’ (SSS) harnessing systems has been explored. Setting of sectional, pressure harness systems used in jacquard have been studied. The arrangements of weave marks of twill damask using the warp face and weft face twills of 4 threads have been analyzed. The different characteristics of the weave have been identified. The methodology of setting the jacquard harness along with healds has been derived corresponding to the weave analysis. It involves in making the harness / ends in two sections; one section is to increase the figuring capacity by scaling the harness and combining it with other section of simple stitching harnessing of ends. Hence, the new harness methodology has been named as ‘section-scale-stitch’ harnessing. The advantages of new SSS harnessing to weave figured twill damask have been recorded. It is observed that the new harnessing methodology has got the advantages like increased figuring capacity with the given jacquard, less strain on the ends and versatility to produce all range of products of twill damask. It is also found that the new harnessing is suitable to weave figured double cloth using interchanging double equal plain cloth, extra warp and extra weft weaving.

Keywords: Harnessing, Jacquard weaving, Scaling, Sectioning, Stitching, Twill damask, Weave analysis

1 Introduction

Damask is patterned textile, deriving its name from the fine patterned fabrics produced in Damascus (Syria) in the European middle ages. True damask or reversible damask was usually made of silk with figure in warp faced satin weave and ground in weft faced sateen weave or vice-versa. But gradually the name came to be applied to all sateen by satin fabric regardless of fibre and fineness. ‘Twill damasks’ or ‘False Damask’[1] is woven with figure in warp faced twill and ground in weft faced twill or vice-versa. To produce damask fabric having large size designs economically, many methods have been devised, whereby considerable numbers of warp threads are commanded by comparatively smaller number of hooks[2]. To increase the figuring capacity of a coarse pitch jacquard, it is necessary to employ different systems of harness building which are additional to the ordinary form of mount. The additions and modifications of the ordinary form of machine are: (i) ordinary healds combined with a harness, (ii) pressure healds combined with a harness, (iii) lifting rods or bars, (iv) sectional harness tie, and (v) special draft.

In the first, some of the ends are controlled by the jacquard and others by the healds. While in the second and third systems, the same ends are operated from two sources, viz. by the jacquard for forming the design, and by the additional parts for producing the structure. In hand-loom, the second system known as the pressure harness[2] is used to weave figured damasks. In this mounting, the jacquard and the healds control the same ends. Whilst the jacquard mails control several ends at a time, the healds control the ends singly. The jacquard cards merely determine where a warp float or a weft float area would be formed in a block type of selection. The healds are used to bind such areas structurally by introducing individual end lifts or drops usually in a satin and sateen order. Due to dual control of ends both by heald and jacquard, the ends cross from top to bottom and bottom to top in between jacquard and healds. This, in turn, causes excessive strain on the ends which are pulled in one direction by the jacquard and in other direction by the healds.

In the fourth system, the hooks are separated into two or more sections and the harness cords from each section are passed through a separate longitudinal

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section of the comber board to correspond with the sections of hooks. Each section is made to control separate set of warp threads[3]. In the fifth system, the warp threads are drawn through harness such that each short row of needles is divided into two parts to control two set of warp threads separately. In some mountings, two or more of the special systems are used in combination.

In Indian Textile industry, handloom sector and decentralized powerloom sector are, even today, mostly using coarse pitch mechanical jacquard machine of smaller hooks capacity ranging from 120 to 400. Any methodology which increases the figuring capacity of jacquard machine is always beneficial to these sectors to produce large size designs using smaller capacity jacquard which is easy to operate manually or with simple mechanical device. In this study, weaving of twill damask in handloom has been taken up which was not discussed so far, using the combination of sectional, scaling and stitching harness system. The new methodology for weaving 4 threads twill damask is discussed in detail and the possibilities of weaving 6 threads and 8 threads twill damask is also studied.

2 Materials and Methods

2.1 Analysis of Twill Damask

The different stages of preparation of 4 threads twill damask weave along with its draft and peg-plan are given in Figs 1(a) - (o) and its analysis is given below in stages.

- The two opposite weaves of 4 end twill (3/1 twill and 1/3 twill) are shown in Figs 1 (a) and (b) respectively using 'x' mark. For weaving twill damask fabric, these two weaves are used in figure and ground respectively. The simple twill damask (check effect) is indicated in 16 × 16, as shown in Fig.1 (c). The weave marks of this twill damask are rearranged by shifting few threads of 3/1 twill, as shown in Fig.1 (d).
- By observing the rearranged twill damask weave in Fig.1 (d), a common weave mark running in both ground and figure is identified. That is, the diagonal line of 1/3 twill weave (ground) is also continuing in the 3/1 twill weave (figure). This continuity of 1/3 twill line in both the weaves is indicated by shading the 'x' mark ('x') as shown in Fig.1 (e). The damask weave [Fig.1 (e)] is split into two sections. The shaded 'x' marks ('x') in the damask weave is alone separated and shown in Fig.1 (f) using the '/' marks. The plain 'x' marks in the damask weave is alone separated and shown in Fig.1 (g).
- All the ends in ground as well as in figure interlace in 1/3 twill order as shown in Fig.1 (f). As the ends are working in simple 1/3 twill order, it is drawn simply in 4 open healds (OHL) in straight draft as shown in Fig.1 (h) and operated as shown at the peg-plan [Fig.1 (i)].
- The repeat of weave derived by condensing the peg-plan [Fig.1 (i)] is given in Fig.1 (j). This weave is the plan to lift the healds.
- All the ends in ground portion are down and all the ends in figure portion are interlacing in 2 & 2 mat weave order as seen in Fig.1 (g). Hence, each hook can control two successive ends. A set of two hooks is made to control 4 ends in the order of 1, 1, 2, 2. Each set of 4 ends, as stated above, are also scaled two times as shown in the draft (k). The doubling and two times scaling put together result in operation of 8 ends by a set of 2 hooks. The scaling can also be three or four times. Thus, figuring capacity of jacquard get multiplied into 4, 6, 8 times.
- The peg-plan of Fig.1 (g) is given in Fig.1 (l). The repeats of figure and ground weaves derived by condensing the peg-plan [Fig.1 (l)] are given in Figs 1 (m) and (n) respectively. These two weaves are used respectively, in the figure and ground parts of punching graph.
- It is also to note that the weaves shown in Figs 1 (f) and (g) are independent in its lifting and do not cross with each other.
- The combined drafting order is shown in Fig. 1 (o) by combining the draft given in Figs 1 (h) and (k).

It is identified from the analysis that the twill damask weave could be separated into two parts of weaves having two different characteristics. One part of the weave is figuring part which could be operated by jacquard and could also be scaled number of times as required. Other part of the weave is simple basic weave which could be operated by set of healds or harnesses. It is also noted that these two sections of weave are independent with each other. It is derived from the combined draft that the figured twill damask could be woven by two sections of shedding device. The first section is of 4 healds shedding, to operate the ends in 1/3 twill order of lifting. The second

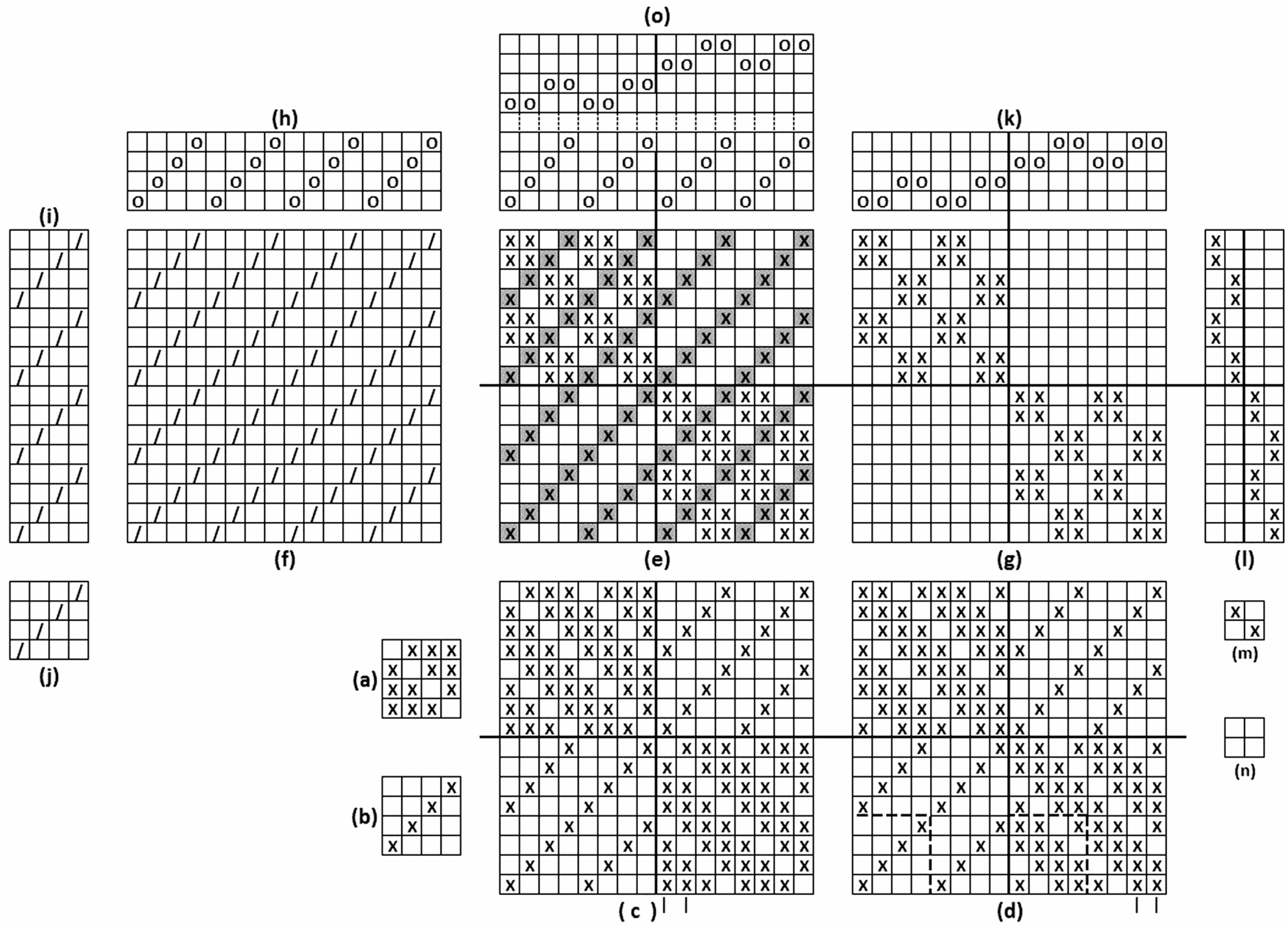

Fig. 1–Analysis of 4 threads twill damask (a) 3/1 twill weave, (b) 1/3 twill weave, (c) twill damask, (d) rearranged 4 thread twill damask, (e) common weave mark is shaded, (f) separated weave of shaded x mark, (g) separated weave of x mark, (h) draft of weave – f, (i) peg-plan of weave – f, (j) condensed weave derived from peg-plan – i, (k) draft of weave – g, (l) peg-plan of weave – g, (m) condensed figure weave derived from peg-plan – l, (n) condensed ground weave derived from peg-plan – l, and (o) combined drafting order

section is of jacquard shedding, to operate the ends in 2 and 2 figuring order. In the second section, each set of two hooks is also scaled two times.

2.2 Loom Setting

In this study, 240 hooks jacquard is taken for experiment. The methodology of setting the loom with the new harness building is experimented along with 4 healds containing open loop heald eye. Out of 240 hooks, 32 hooks in first four short rows (4 × 8) are employed for operating ends in twill order, through four open healds. Each heald is connected to a row of 8 hooks. These 32 hooks are named as heald hooks (HH). The remaining 208 hooks from 33 to 240 hooks (26 rows) are employed for operating the ends in figuring order. These 208 hooks are named as figuring hooks (FH). Each figuring hook is connected to two successive harnesses and set of two hooks is scaled two times. That is 2 hooks control 4 harnesses or ends. The first eight figuring hooks are connected to 32 harnesses in the order of: 1, 1, 2, 2, 1, 1, 2, 2; 3, 3, 4, 4, 3, 3, 4, 4; 5, 5, 6, 6, 5, 5, 6, 6; 7, 7, 8, 8, 7, 7, 8, 8. Thus, 208 hooks control 832 (208 × 4) ends per repeat.

In front of the harnesses, 4 healds are set and connected to first four rows of the jacquard serially. The eye of heald wires is an open loop of 3” to 4”. This facilitates lifting of ends by jacquard independently without having any hindrance put by its drawing through healds. All the 832 ends per repeat are first drawn through the harnesses in straight order and then drawn through these 4 open healds in 1, 2, 3, 4 order. The harness building, heald setting and drafting are shown in Fig. 2.

2.3 Graph Designing, Punching, Lacing and Weaving

The steps involved in the preparation of guide graph and punching graph are also evolved with calculation of its size. Cards are punched as per the

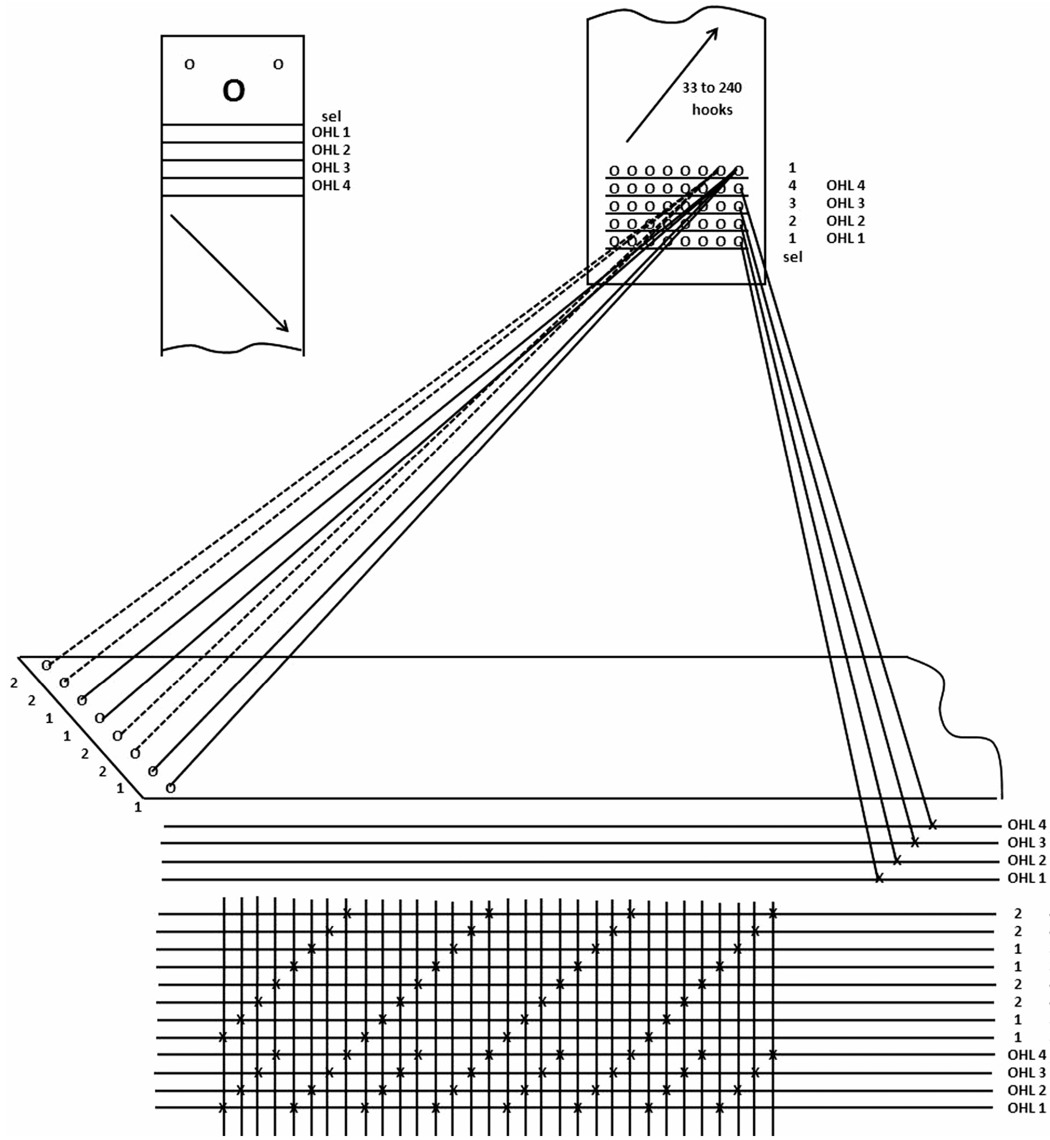

Fig. 2–Hooks division, harness building, healds connection and drafting order in the loom

derived punching procedure. A sample is developed to note the working of harness system along with healds as described below.

In graph designing, a guide graph is prepared first and then the punching graph. The size of guide graph is 104 ends × 104 picks. As the loom is set making 2 hooks to control 4 ends in 1, 1, 2, 2 order, the guide graph for FH is prepared by taking 104 ends (208 FH / 2). The picks taken in the guide graph is also 104, considering that the picks per inch are equal to ends per inch. The design is enlarged and stepped. The stepped design in 104 × 104 is made into punching graph of 208 × 208 size, by scaling 2 times in the end way and 2 times in the pick way. The figure portion of punching graph is filled with plain weave as shown at Fig. 1(m) and the ground portion is left blank as given at Fig. 1(n). The reading of graph must be from left to right while punching.

The punching procedure for a repeat of 8 cards is given in the Table 1. Totally 832 cards are punched by punching all the 208 picks of the graph. From each set of 2 picks, eight cards are punched to make the scaling of picks proportionate to the two times scaling of four ends by the scaling of harness. The cards are laced in the order of: 1, 2, 3, 4, 5, 6, 7, 8 ………….. and so on.

After mounting the chain of 832 cards in the loom, weaving is carried with single shuttle by operating the jacquard with single treadle continuously. A repeat of the design is completed after weaving 832 picks.

A part of the guide graph in 8 × 8 is shown at Fig. 3(a). The corresponding punching graph is given at Fig. 3(b) in 16 × 16. Four punched cards, punched from the first 2 picks of the punching graph are shown at Fig 3(c). The interweaving of 48 ends x 48 picks with 1/3 twill in the ground and 3/1 twill in the figure is shown in Fig. 3(d). This graph correspond to the top left of 6 × 6 of the guide graph in 8 × 8 and to the top left of 12 ×12 of the punching graph.

The new SSS harnessing can also be set to weave 6 thread and 8 threads twill damask. The basic rearrangement and sectioning of 6 threads and 8 threads twill damask are shown at Figs 4(a) and (b) respectively. Figure 4(c) shows the sectioning of interchanging double equal plain cloth weave to produce figured double cloth using the new harnessing system.

3 Results and Discussion

The advantages of new methodology in comparison with the pressure harnessing technique are discussed hereunder. While weaving, for each pick, an open head is lifted along with the lifting of harness. The lifting of ends by the harness is independent of the lifting of ends by the healds. For the first pick, when the first heald is up, out of each set of 4 ends, the first series of ends in the sequence of 1, 5, 9, 13, 17, 21, 25, 29 ………is completely lifted. The second series of ends in the sequence of 2, 6, 10, 14, 18, 22, 26, 30 ……..is completely down. In the figure portion, the third and fourth series of ends together are lifted up by the jacquard (if punched) and form 3/1 interlacement combining with the ends raised by the heald in that portion. In the ground portion, the third and fourth series of ends are left down by the jacquard (if not punched) and form 1/3 interlacement by the ends raised by the heald in that portion.

Table 1–Punching procedure for a repeat of 8 cards

Serial order of card	Row to punch, out of first four rows	Pick to punch, from the punching graph	Numbering of cards
First card	First row	First Pick	1
Second card	Second row	First Pick	2
Third card	First row	First Pick	5
Fourth card	Second row	First Pick	6
Fifth card	Third row	Second Pick	3
Sixth card	Fourth row	Second Pick	4
Seventh card	Third row	Second Pick	7
Eighth card	Fourth row	Second Pick	8

2 picks of the graph = 8 cards
208 picks of the graph = 832 cards

However, the lift of ends by the healds also lifts the corresponding harnesses through which the ends are drawn at the backside. By this, there is slackness formed in all the harnesses at the back side. This slackness does not create any hindrance or crossing or undue strain on the ends, as all the ends are individually drawn in the harness. On the other hand, the lingos tied for bringing down the harnesses helps to bring down the heald shaft without any separate reversing mechanism (dead weight). Hence, absolutely clear shedding is obtained without crossing of ends, resulting in strain free lifting of ends. Besides, the methodology involves only lifting of heald from bottom closed shed and no need of any lowering of healds as seen in the operation of pressure harness.

The figuring capacity of given jacquard is increased more than the other techniques. In this new harnessing method, 208 figuring hooks of jacquard result in operating 832 ends per repeat and the 832 cards result in 832 picks per repeat. Therefore, the size of the repeat of 832 ends x 832 picks is 16” x 16”, if 54 ends per inch are used on the reed and 54 picks per inch on the loom. In simple scaling of harnessing method, when 4 hooks per set is scaled for 2 times (1, 2, 3, 4 – 2 times), 240 hooks result in only 480 ends per repeat [(240/4)*8]. The size of the repeat would be only 8.8”. The size of guide graph of simple scaling method would be 60 ends x 60 picks for a square design. Whereas, in the new SSS harnessing method of 208 hooks, the guide graph is prepared in 104 ends x 104 picks for a square design, which means that the new methodology could produce more elaborate design when compared with simple scaled harnessing.

It is also possible to have the SSS harnessing methodology without using healds. The set of hooks used for controlling the healds are connected to have another set of harness cords. Each harness cord from the first set of hook together with each harness cord from the figuring hook controls an end. In other words, each end is made to control by double harnesses, one from figuring hook (33 - 240 hooks) and other from the set of hooks of first four rows (1 - 32 hooks). In this principle, the methodology is the combination of sectional- scaled – double stitched harnessing.

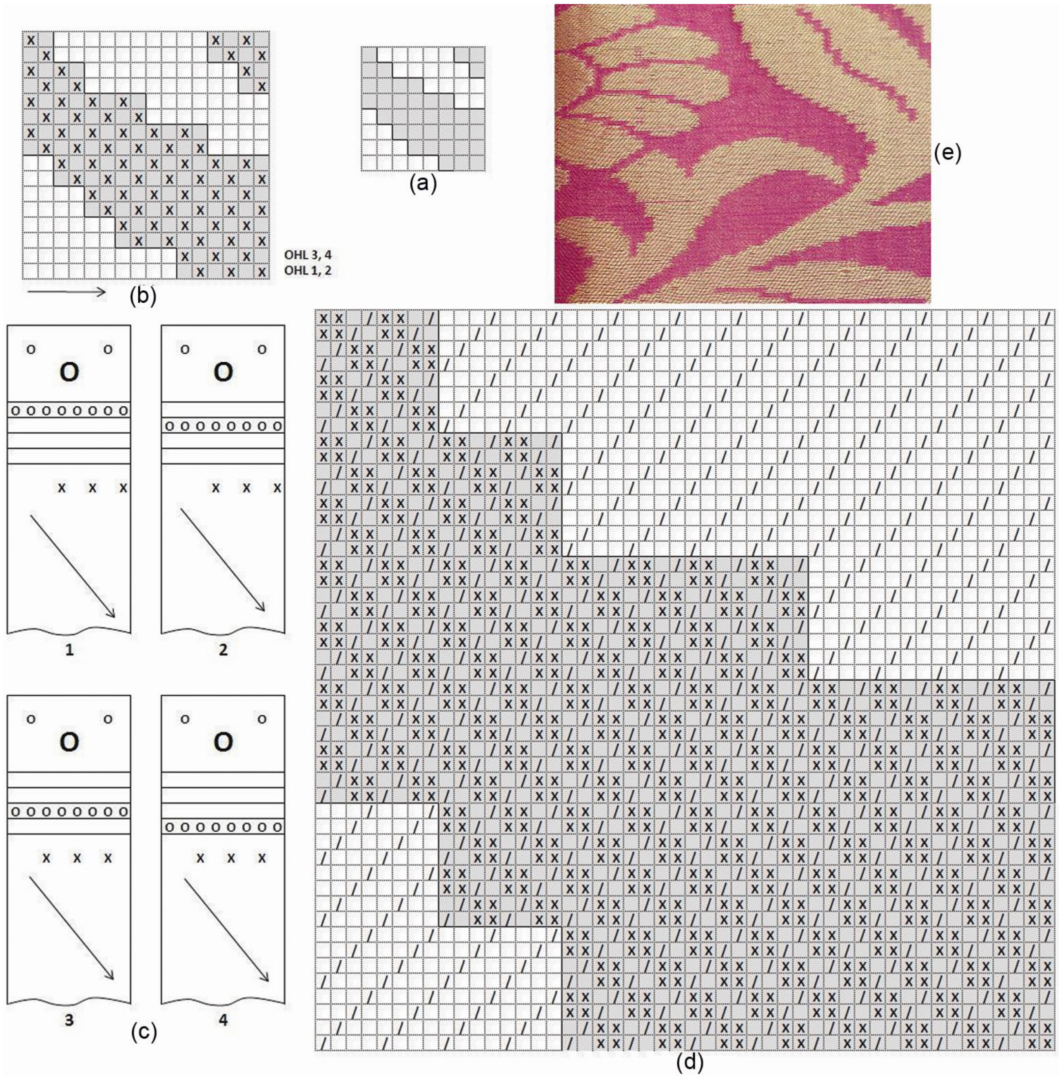

Fig. 3–(a) guide graph, (b) punching graph, (c) four punched cards, (d) interweaving of 48 ends × 48 picks in the cloth, and (e) 4 threads twill damask cloth woven by using SSS harnessing.

In handloom, the double harnessing methodology can be very well used for weaving large size extra warp border twill damask designs in silk sarees using smaller capacity jacquard like 240 hooks which is easy to operate by the weaver along with ground healds. It is also possible to use this methodology to weave large size extra weft pallau designs. This new SSS methodology is also useful to weave figured interchanging plain weave double cloth. The loom set to weave 4 threads twill damask can be very well used to weave the figured double cloth if the ends per inch are same in both the cases. The only change to be made is, to redraw the ends such that the order become 1, 2, 1, 2, 1, 2, 1,2 instead of 1, 1, 2, 2, 1, 1, 2, 2.

As explained above, a loom is set to weave the border of silk saree in extra weft principle. The construction particulars of the fabric are: warp – 20-22 × 2 denier, weft – 20-22 × 3 denier and gold zari, ends per inch – 84 and picks per inch – 160 (80 silk and 80 zari). The photograph of extra weft fabric sample woven using the new harnessing methodology is shown in Fig. 3(e). This methodology was introduced in the Arni handloom cluster to weave borders and pallau designs of silk sarees and practical successfulness has been proved. Necessary steps are also initiated to introduce the methodology in other handloom and powerloom clusters like Chennimalai and Karur to weave coarser and medium varieties of home furnishings.

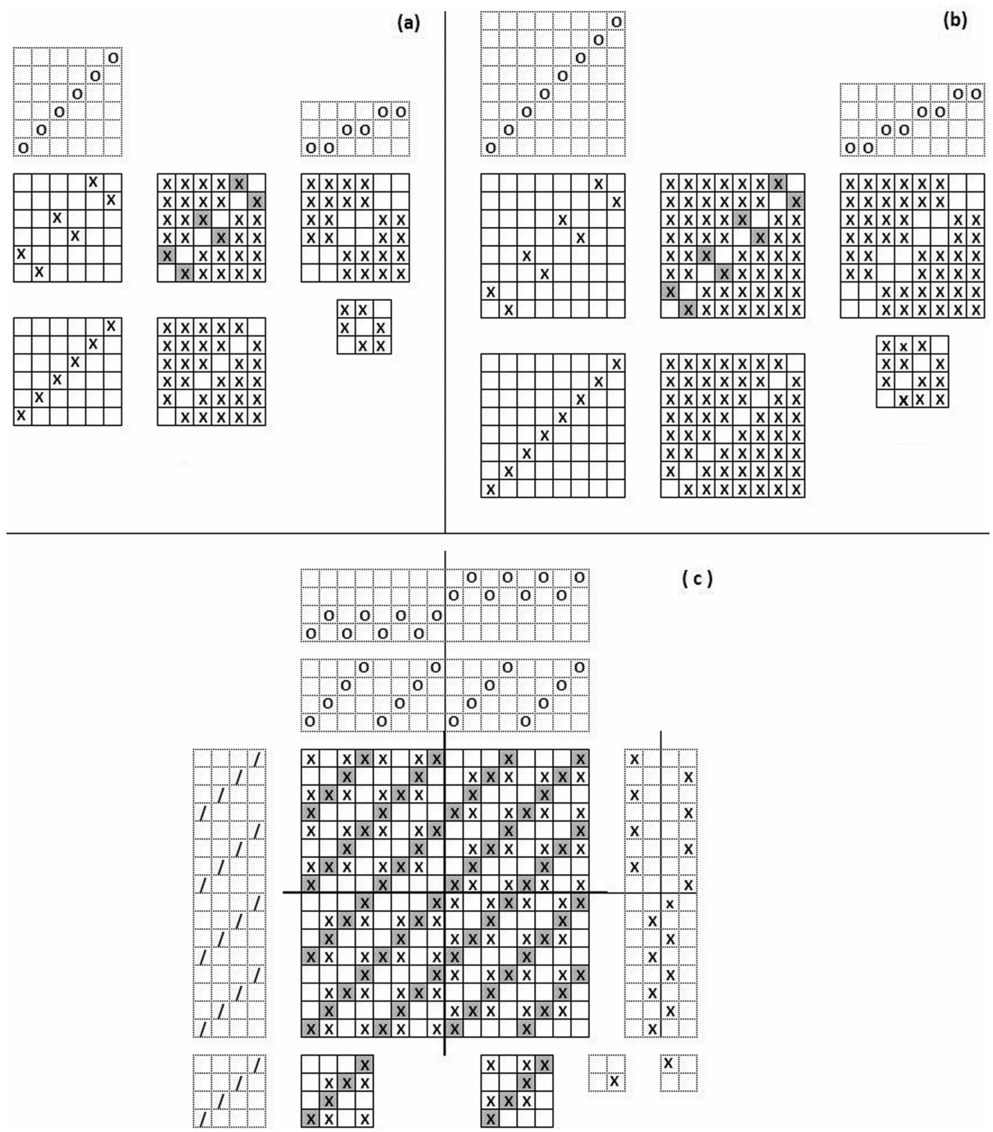

Fig. 4–Separation of (a) 6 threads twill damask, (b) 8 threads twill damask, and (c) interchanging double equal plain cloth

4 Conclusion

The new methodology derived in the study, which is the combination of sectional harnessing, scaling of harnessing and stitching of harnessing by using jacquard and heald, has got collective advantages of all these three systems of harness building and loom setting. It does not require any additional cost to mount this methodology. The weave structures viz. twill damask, plain double cloth, extra warp and extra weft can be woven by using this new methodology in all range of counts. This methodology is useful for the saree manufacturers to produce elegant - fine - silk sarees having decorative large size figured designs of twill damask as extra warp or extra weft borders combined with extra weft pallau, which have got excellent demand in niche domestic market. This methodology is also useful for the home furnishing manufacturers to produce coarser and medium count range bed linen, table cover and table mat with large size figured designs of interchange double cloth weave, which have got good demand in export market.

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