BRIDGES
Mathematical Connections
in Art, Music, and Science

A Collaborative Parabolic Quilt

Mary C. Williams
8962 E. Sugar Sumac St.
Tucson, AZ 85747
merynda54@hotmail.com

John Sharp
20 The Glebe
Watford
Herts, England WD25 0LR
sliceforms@compuserve.com

Abstract

Bridges is about the connections across art and science/mathematics. In this paper we present a collaboration. Mary Williams has created a quilt using a design idea by John Sharp.

The basis of the collaboration (John Sharp)

Some people come to Bridges to see what is happening, others to communicate their work, but it is also a meeting of like minds and the talking that happens outside the formal sessions is very important. This project began when we showed one another our work at the third Bridges Conference in 2000. I had been looking for someone to work with to bring my designs to life and was particularly interested in some form of needlecraft since many of my students are such craftspersons. Mary seemed a kindred spirit and was obvious very skilled in this area. After the conference we had various email exchanges over the next year trying to find something that was suitable. The idea was one I had used in op-art painting in the 1970s and had resurfaced in class I ran on grids and subsequently in a project to provide mathematics resources on the web as a UK Government initiative [1]. The origin of the design is described at the end of this paper.

Creating the quilt (Mary Williams)

A quilt consists of three layers; a back of fabric, an interior batting and a top of fabric held together by thread. The back may be a plain fabric or may be as colorful as the top and in the case of large quilts is long pieces sewn together. The batting originated as one of the steps in making yarn. After cotton or wool is plucked or shorn it is cleaned. Then it is pulled through a carding machine to make the fibers go in the same direction. It resembles a puffy cushion. If you want yarn, you go on to spin the batting on a wheel. Now, there are batts of cotton, wool, polyester and even silk.

The top is more difficult to explain. There are whole cloth tops, where the quilted design is the main point. Two main ways of assembling tops are piecing and appliqué. Appliqué is placing one cut to a particular shape fabric onto to another larger piece and sewing by hand or machine the first piece down. Appliqué lends itself to representational shapes; birds, flowers, balloons, teddy bears. Piecing is taking a unit called a block and repeating it symmetrically to get the size of quilt that is desired. Pieced quilts are tessellations but not all tessellations lend themselves to quilt designs. Each tile within the block is a piece and typically a different color.

John had given me the 8 X 8 grid and then simplified it to the 4X 4 grid to reduce the number of pieces and complexity of seaming. I liked both designs but agreed that the 8 X 8 was a little complicated. I drew it at 8 inches by 8 inches and at 16 inches by 16 inches. The eight inch block would be a 32 inch square quilt suitable for a wall hanging, while sixteen inch block yielded a 64 inch square quilt more in use as a lap quilt. I calculated the time involved to quilt the larger quilt and decided against it. I redrew the grid as a 6 X 6 and drew it as a twelve inch block with a 48 inch square quilt for the end result.

Next, I drew the pattern on graph paper. I labeled the pieces, copied it, cut it up, glued it to another piece of paper and added ¼" seam allowances. The overall design then looked like this (figure 1)

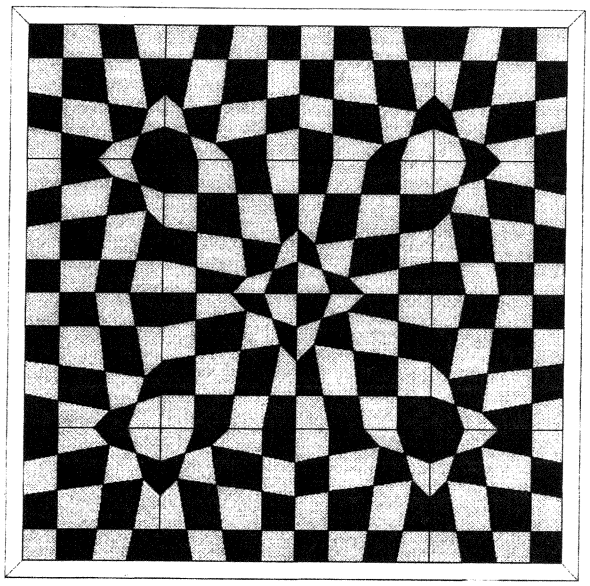
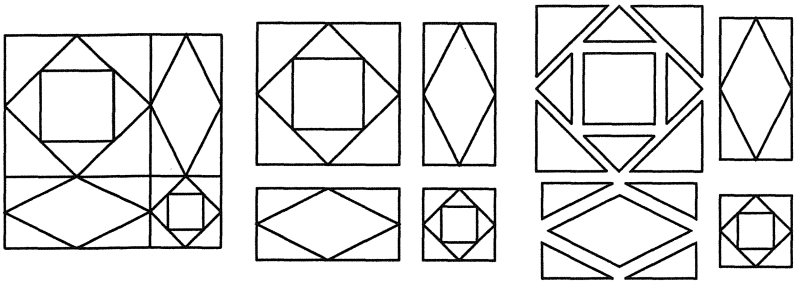


Figure 1 sketched design

We had discussed who would get this quilt and finally got to the fact that there would be two; one for each of us in different colors. Then I picked out sufficient fabric in each color scheme. Because there is a mathematical basis for these quilts, I decided that there would be very few representational prints in the fabric. Then I cut the pieces and assembled them. Because sewing more than a straight seam it is more difficult to get correctly by machine, I machine pieced the straight seams and hand pieced the parabolic curve seam. Figures 2 and 3 show examples to explain pictorially how a design has to broken down when the seams are 'set in'.

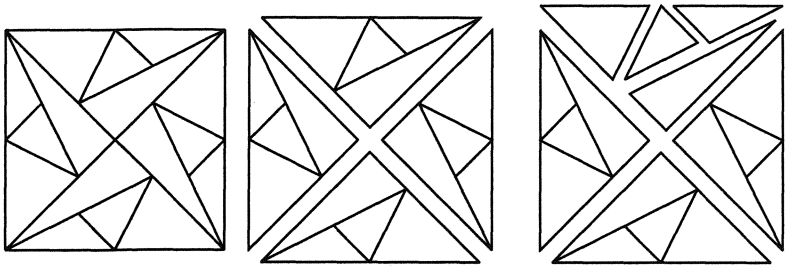
In figure 2a, the design known as "Storm at sea" is first broken down into rectangles, and then each rectangle is broken down into its component parts. Similarly with figure 2b, the design known as "Laced star" is first broken down into four triangles, and then each of these is further broken down into its component triangles.

When the seams are 'set in', there are often alternative ways to conceive the design. In figure 3a, the design known as "Attic windows" can be realized with the square complete, or it can be broken into two triangles and then two component triangles created.



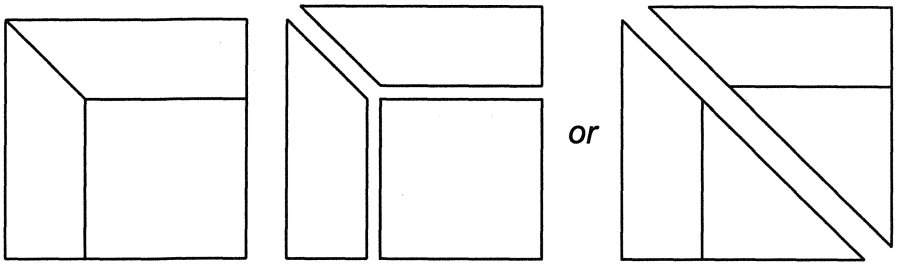
"Storm at sea", straight seams

Figure 2a



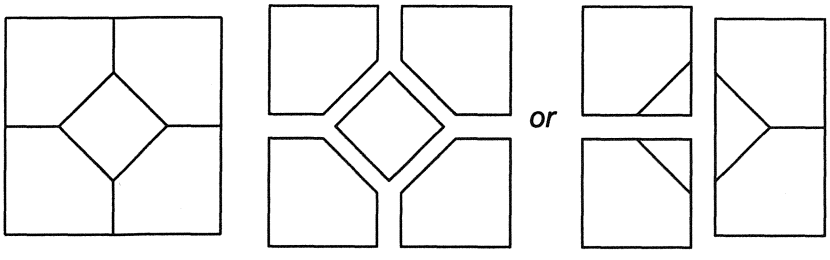
"Laced star", straight seams

Figure 2b



"Attic windows", non-straight seams

Figure 3a



"Bow-tie", non-straight seams

Figure 3b

With the "Bow-tie" block the traditional method is to hand piece one square with four squares with missing corners, while the alternative is to cut the square into four triangles, seam each triangle to a square missing a corner and then sew the pieces into the block.
An alternative to the hand piecing of the parabolic curve would have been to allow the removed line (see figure 6) to remain but would have added a number of very small and hard to sew seams.

I basted the quilts using safety pins and then quilted by hand. A running stitch in which you repeatedly stab your under finger may be used. I prefer a stab stitch in which the right hand sends the needle down and the left (under) hand returns it.

It took me a month to assemble the quilt tops and about four months to quilt both of them. Finished sizes are 32" X 32" for the blue and yellow and 48" X 48" for the blue and green. Figure 4 shows the final result.

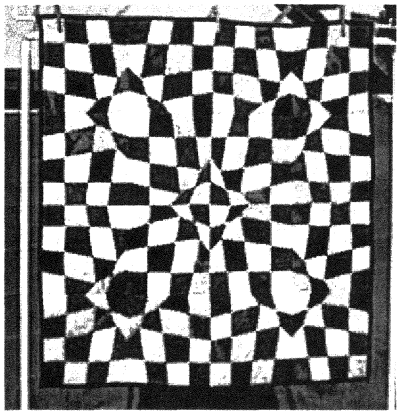


Figure 4a final quilt, yellow version

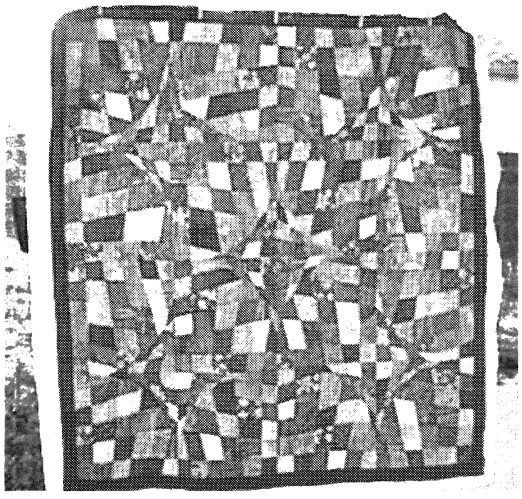


Figure 4a final quilt, blue and green version

The design system (John Sharp)

Curve stitching is a common way of teaching primary school children about curves which uses stitched threads to create curves as envelopes. The most common design is a parabola which is created as follows.

1. Draw two axes and mark off equal divisions. In this example eight divisions are used.
2. Starting with the origin as point 0, label the points on the x axis, 0 to 8.
3. Starting with the origin as point 7, label the points on the y axis 8 to 0.
4. Join points on the two axes so that as you go away from the origin on one axis, you move towards the origin on the other one and the sum of the labels on the points adds up to 7.

The parabola appears as an envelope of the lines shown in figure 5

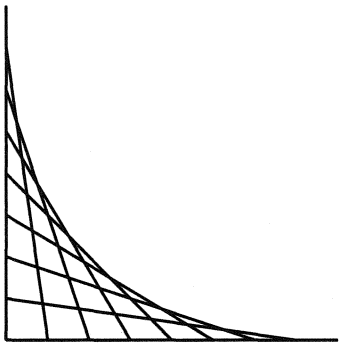


Figure 5, basic parabola

This curved stitched parabola has some grid effects, but does not look as if it would be suitable for patchwork quilting. It has some triangles as well as quadrilaterals. The steps to conversion to a suitable grid are shown in figure 6.

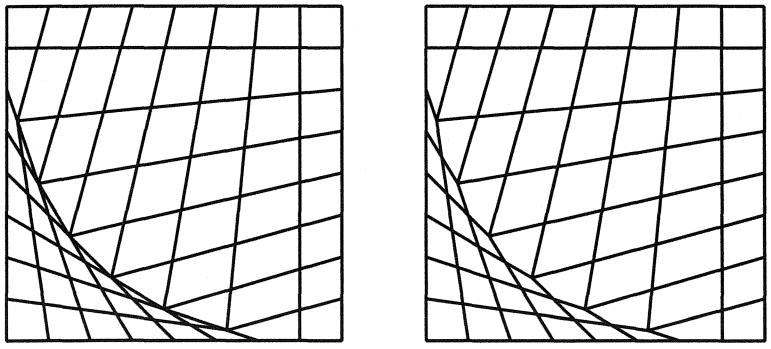


Figure 6,

In the left diagram, points are marked at equal spacing around the box and then those on the right and top side joined to the intersections of the parabola grid. Then the parts of the lines forming the parabola are removed as shown at the right to give sets of quadrilaterals. Such a grid is too dense for patchwork. The one we have used, which forms the unit has fewer lines as shown in figure 7.

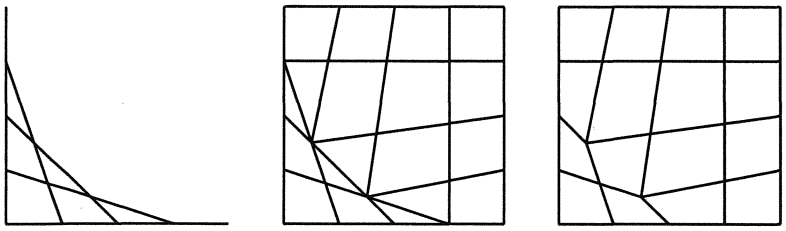


Figure 7

Note that there are ten distinct quadrilateral shapes which is useful when working with a patchwork quilt. To make an 8 by 8 grid, these units can be joined in different ways because there is only one axis of symmetry, along the diagonal through the origin. These grids can be joined in this way because the grid is warped internally and the edges have equal divisions. Note also that the unit can be shaded in two ways as shown in figure 8.

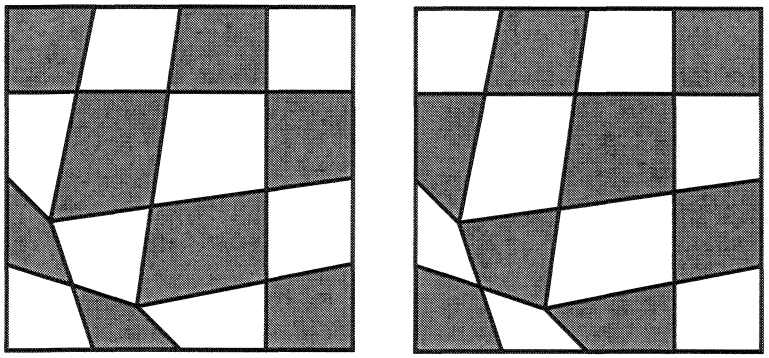


Figure 8

Different effects can be obtained by changing the orientation of the units when they are assembled into a design as shown in figure 9

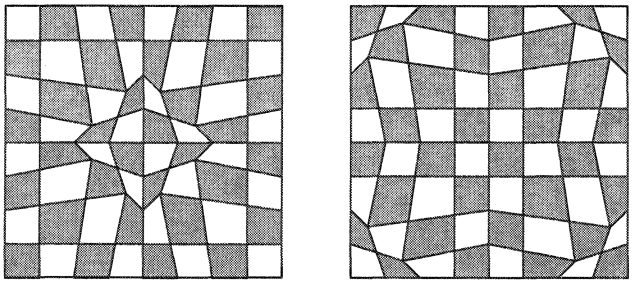


Figure 9

and by using the property that the parabola is tangent to the side of the square, then the curve can be made to flow and produce some interesting effects as shown in figure 10.

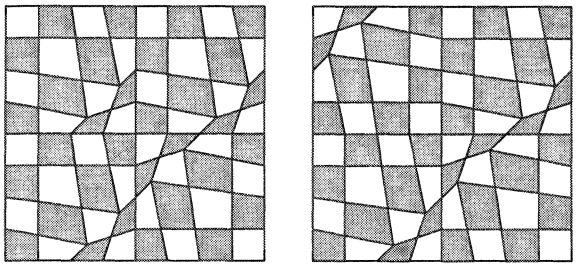


Figure 10

Different coloring using a checkerboard can be used to change the appearance. The examples in figures 9 and 10 are straight checkerboards, but Mary has been more subtle in her use of the two versions of the unit design thus making it more interesting because it is not quite as straight forward as it looks.

Reference

[1] John Sharp *GridWarps - Parabolic grids from Curve stitching* one of the methods described in the Explorer section on the award winning CountOn website at www.counton.org, a website set up by the Department for Education and Science of the UK Government as a mathematics resource for education.