Triaxial Bias Plaited Basketry
Theory, Structure and Technique

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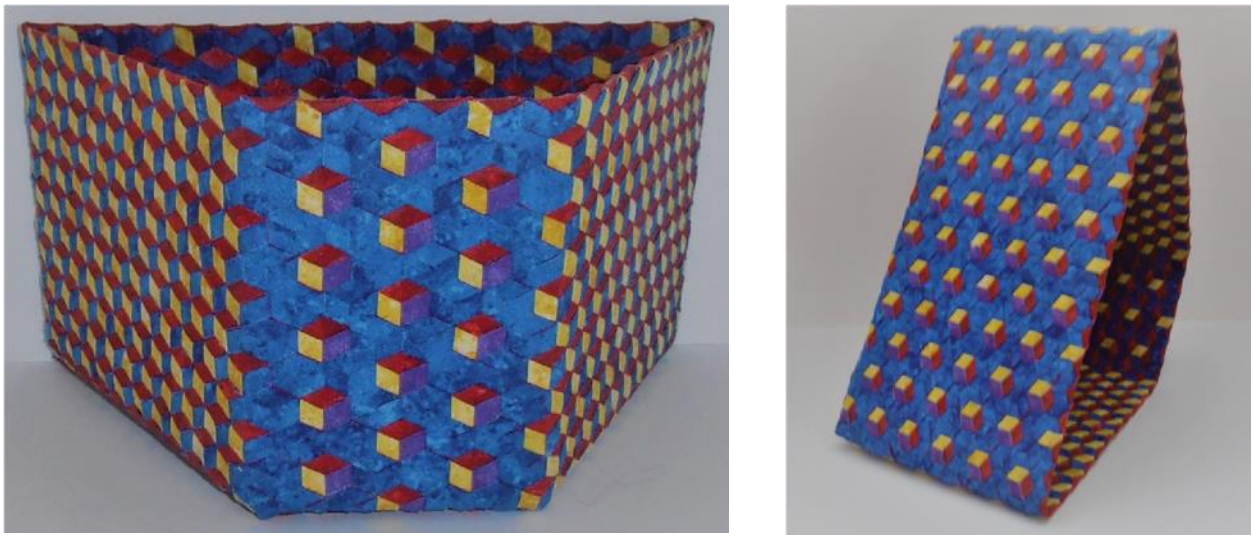
Triaxial Bias Plaited Basketry: Theory, Structure and Technique

Susan Brunton

My thesis presents an ancient form of weaving knowledge known as triaxial bias plaited basketry. Informed by forty- plus years of studio practice my research investigates this advanced technique that uses three elements, woven at sixty degrees from each other, in a closed hexagonal structure. The technique presently is not widely known or practised; triaxial bias plaited basketry is in danger of extinction. My research asks: How can triaxial bias plaited basketry be preserved, and what approaches can be taken to help understand the complexity of its construction and pattern for future weavers? Drawing together written and visual resources, I first compile a body of historical knowledge, then apply an inductive mathematical theory of *Making with Rigour: MathWeave* to conduct an evidence-based approach toward research-creation methods. Key design elements of colour and weave techniques are fundamental to weaving, yet a critical gap in the knowledge of triaxial bias plaited basketry was made evident in the initial research. Responding to this knowledge gap, a practice-based research method was undertaken to document the creation of 52 experimental baskets, proposing new knowledge of colour placement pattern control and weave techniques. This research provides applied math and colour theory with advanced weaving knowledge, encouraging current and future basket makers to participate in triaxial bias plaited basketry, working toward the preservation of this technology.



Triaxial Bias Plaited Basketry Art (Brunton 2021)

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Introduction

My research investigates triaxial bias plaited basketry, a weave structure using three elements, woven 60 degrees from each other as they enter the web creating a surface of cubes. This ancient technique presently not widely studied or practised faces an uncertain future and possible extinction. Using autoethnography and narrative inquiry, I speak from within my forty plus years of weaving and basketry practice to share my experiences and research with triaxial bias plaited basketry.

Drawing together research from written and visual resources, I analyze, structure and add practical expertise to generate a working body of triaxial bias plaited basketry knowledge. My research reveals the lack of theory and colour design techniques in the existing knowledge base.

Studying the archaeology, anthropology and history of baskets reveals the age and place of basketry in early human history and development. Basketry was the first technology developed by early humans (Adovasio 2016). Using single element construction such as coiling, plus biaxial and triaxial methods of basket construction and plaiting, baskets fashioned from materials available in the maker's immediate environment were used in every facet of their lives (Harvey 1991).

From antiquity, baskets were primarily utilitarian, made and used for domestic, occupational and agricultural purposes (Harvey 1991). Occasionally baskets were made for special purposes and were prized possessions. In modern times, makers creating utilitarian and art vessels became part of the Fiber Art / Textile Art movement (Baizerman 2004).

Textile structure and theory provides the critical background and framework for this research using basketry classification and consistency in patterning as underlying guiding principles to develop technique. Basket making is considered part of the textile classification system. At present the textile classification system consists of single and double element textiles (Emery 2009). To date triaxial textiles have not been written into the textile classification for handwoven or textiles constructed by the maker's hand.

This omission is a gap in the triaxial textile literature. My thesis introduces triaxial weaving and basket making into the textile classification and theory for handwoven and basketry makers. In the textile classification for triaxial weaving, bias and non-bias techniques are included.

The present day triaxial basket makers can be loosely grouped into two categories, contemporary textile art basket makers and traditional basket makers. Contemporary textile art triaxial bias basketry makers use the triaxial structure in their work, however they are not limited to traditional

shapes, uses or weaving materials. Triaxial textile artists are free to experiment and develop their own designs and shapes.

Traditional makers produce baskets that have been passed down from maker to maker for generations. In general, traditional makers focus on utility baskets used in daily living and working lives. However, the usefulness and purpose of a basket do not exclude it from being viewed and appreciated as a work of art. For the purposes of this thesis traditional basket makers from Malaysia who specialize in triaxial weaving are acknowledged as traditional triaxial bias plaited makers who grow, gather and process their own weaving material (Barnes 1993).

Modern makers have access to various options for weaving materials, such as purchasing weaving materials from a supplier, or growing and gathering materials to be processed by the weaver. Traditional and modern makers who harvest their own weaving materials are aware of the negative environmental impact to their weaving materials from modern society, agriculture and industry. For many makers the loss of natural materials prevents them from practising their weaving and basketry traditions (Gerimis Art Project 2020).

Triaxial bias plaited basketry is an obscure and difficult technique attracting only a few modern-day makers. This style of basketry is

endangered of becoming extinct, taking with it valuable theory and technique with the loss of intangible cultural heritage. This research brings together and consolidates the available literature and resources to formalize an initial body of knowledge of triaxial bias plaited basketry. Through this body of knowledge, students, teachers and makers will have access to an organized assemblage of practical and technical knowledge.

The lack of colour and weave technique uncovered in the research to consolidate a body of knowledge for triaxial bias plaited basketry forms the foundation of the new research. The techniques developed herein will give makers new tools to understand how colour informs the weave structure and how this approach can be applied to their work by opening design options and hopefully encouraging interest in this basketry technique.

Building textile knowledge and theory for triaxial bias plaited basketry is done by using weave structure and colour to develop and execute triaxial patterns. The experimental aspect of this thesis examines pattern as a result of structure and colour placement interaction in three directional plaiting. To build theory it is necessary to develop and synthesize complex ideas and set out the format and strategies to make complex systems and ideas workable for any maker.

Bringing together the existing literature, history, technique and experience from the maker's hands leads to the research question for this thesis: How can the existing triaxial bias plaited basketry resources, plus practical knowledge be assembled, analyzed then structured to enhance with new techniques and preserve a working body of theory and technique serving present and future triaxial weavers?

The research question is actualized by fulfilling three research objectives: First, to create a working body of knowledge embodying existing triaxial bias plaited basketry theory, technique and practice. Secondly, to develop new colour and weave design techniques to advance the knowledge and provide new design elements for present and future triaxial weavers. Lastly, to create a document to preserve and disseminate triaxial bias plaited basketry knowledge, theory and technique for present and future makers.

Despite the research developments in this thesis of triaxial weaving, knowledge consolidation and development of colour and weave techniques, more extensive research is needed in the textile classification system covering flat textiles plus bias and non-bias basketry for handweavers and industrial uses. Further research into different structural patterns in three element textile structures focusing on the interaction of

colour is needed. Also, the structural attributes of triaxial weave used in industry and the academic study of mathematics, chemistry, physics and engineering are not included in this research (Tyler 2011).

In addition to this Introduction chapter, my thesis consists of four more chapters. The second chapter is the Literature Review which brings together all the written and visual handwoven triaxial bias plaited basketry materials available at the time of writing this thesis forming the foundation of the body of knowledge for triaxial bias plaited basket making. The third chapter, Research Methodology, presents the use of practice-based research and the MathWeave group's methodology of Making with Rigour which I used to systematically deconstruct the handwoven triaxial bias plaited basketry to build the foundation of the experimental research done for this thesis (Knoll, Landry, Taylor, Carreiro 2012).

In the fourth chapter, Experimental Results, the eleven-step experimental process developed through the methodology chapter uses the structural pattern Tumbling Blocks and seven colour patterns to analyse and, where necessary, develop the colour and weave technique required for colour pattern adjustments. In total 52 experimental baskets were woven, with each basket successfully creating the colour pattern adaptations to provide accurate colour and weave techniques for the use of colour

patterns in triaxial bias plaited basketry. The last chapter, Conclusions and Discussion, brings together the research topic and objectives plus experimental results. Experimental research conducted in this thesis adds colour and weave techniques responding to the lack of colour theory in triaxial bias plaited basketry.

Chapter Two - Literature Review

Basket Technology – Triaxial Bias Plaited Basketry

In this literature review, I assembled written and picture resources gathered over years of studying and making triaxial bias plaited basketry. Through my research I have found many gaps in the knowledge base, from its origins to contemporary hand plaited processes. Working from the available resources I gather the foundational texts to begin consolidating and developing triaxial bias plaited basketry history, theory, technique and practice.

The Age and Place of Basket Technology

Archaeology, Anthropology, and History

Studying the archaeology, anthropology and history of basket technology reveals the age and place of basketry in human history and evolution. Archaeologist J.M. Adovasio's *Basketry Technology: A Guide to Identification and Analysis*, dates basket making from 27,000 years ago in the Neolithic period through analyzing negative basket wall impressions in clay. Basketry was one of the first technologies developed by humans. Using materials available in their environment, early humans made and used baskets, linking them to modern basket makers through the

unbroken transmission of ancient basket technology and natural history (Rossbach 1997).

Basketry's vast and complex history is complicated for archaeologists to chronicle, as natural, plant-based basket materials are biodegradable and decompose after the useful life of a basket is over. Environments that inhibit the degradation of plant fibre artifacts, such as dry caves and rock shelters in arid to semi-arid parts of the world, or waterlogged conditions or permafrozen environments, allow evidence of basket technology to survive from antiquity. Also, as noted above, a basket's wall structure preserved in clay records the method of construction for the basket and the archaeological find can be dated to determine its age (Adovasio 2016; Jørgensen, Gröme, and Gröme 2013).

All cultures on Earth have basket weaving traditions; however, the key to the success and survival of basketry technology is an intimate understanding of the natural environment (McDowall 2013; Jensen 1991). Neither the cultures that developed specialized basketry nor the material culture that fostered these creations are static, as conditions are constantly changing (Dietrich 2014). Before industrialization, basket technology was used to build tools to fulfill specific purposes. Baskets were made throughout history for multiple purposes in the community as the function and utility were the primary reason for craft production (Sellato, Swayne, and Ball 2012).

Basket making is one way in which cultures, beliefs and traditional values can be kept alive (Sentance 2001). In South East Asia triaxial bias plaited basketry, referred to as Anyam Gila or Mad Weave in the English translation, has been practised for millennia. The majority of Mad Weave baskets are not decorated; however, the addition of colour inlay or twisting and turning of the weaving strips to add texture to the basket surface can be used to denote a special occasion or by choice of the basket maker (Barnes 1993).

Pouch or hexagonal boxes with lids, woven as ceremonial Betel containers, have social significance among communities partaking in this tradition (Barnes 1993). A mixture of fruit, leaves and lime is prepared and wrapped in the leaf of sirih-pepper and placed in an Anyam Gila ceremonial container. The Betel containers may also hold personal treasures; however, some individuals prefer to have a separate unique treasure container (Barnes 1993). The pictures fig.1,2 show Anyam Gila pouches and baskets made from hand gathered and prepared natural fiber from Pandanus plants (Gerai OA 2017).

Figure 1. Anyam Gila, triaxial bias plaited basket (Gerai OA 2017).

Figure 2. Mad Weave Pouches (Gerai OA 2017).

Baskets are still used today as utility items, artistic and cultural objects.

Basket Making in the Development of Textile / Fiber Art

Fiber Art Revolution of the 1950's to the 70's – The Birth of Fiber Art

During the 1950's to the 1970's, weavers, basket makers and other textile practitioners fought for their position in the fine art community. These efforts launched Fiber Art as a legitimate member of the fine art world. Basketmakers were no longer classified based on the end-use of their baskets (Rossbach 1997). Ed Rossbach was recognized as a seminal figure; inventive, independent and an innovator in the process of developing textile Fiber Art (Rossbach 1980). Fibre Art's critical formative years in the 1960's and 1970's coincided with the awareness of diverse material cultures, seeing traditional basketry enter Fiber Art as an expression of art and design. Fiber Art is grounded in textile traditions from around the world (Park 2004).

Fiber Art is a hybrid art, influenced by the fine art world but also connected to crafts by its historical roots. Basket art legitimized the maker's work in the modern art world (Corwin 1986; Park 2004). Artists now use basketry as one of the forms of their art expression in fiber. Contemporary baskets are now made not only as imitations of past work but as something fresh, original and individual (Rossbach 1980).

The book *500 Baskets A Celebration of the Basketmakers Art,* highlights colour, form and texture in contemporary baskets. Advancing from Fiber

Art's beginning, modern makers employ a vast combination of materials and techniques to move forward from the idea of a simple basket to a sophisticated vessel and onward to sculptural form (Kieffer 2006).

Figure 3. Triaxial Bias plaited Basketry Art (Brunton 2021).

Traditional forms of basketry are still practised worldwide; however, makers are not confined to traditional basket forms, shapes, patterns and materials used to construct weaving strips. Adaptation and innovation in basketry design keep basketry art flourishing.

Triaxial Bias Plaited Basketry in Textile Theory and Structure

Triaxial weaving is part of the textile classification system, which includes single and bi-axial construction, industrial, commercial and hand-assembled textiles including basketry. The theory and structure of triaxial weaving for handwoven textiles and basketry have not been written. This is a significant gap in textile knowledge and needs to be addressed. My work in this thesis is a beginning step in formalizing the theory and technique of colour and weave control in triaxial bias plaited basketry.

J.M. Adovasio is an expert in the field of basket archaeology and views basketry as a variety of textile classification, showing three ways of basket construction; twining, coiling and plaiting. The wide and diverse types of basketry items considered in the textile classification of basket technology are fundamentally similar because they are constructed by hand, without frame, loom or other auxiliary apparatus (Adovasio 2016).

In developing the theory and structure of triaxial bias plaited basketry I will extrapolate from bi-axial handweaving and basketry literature to make the theoretical connections to triaxial bias plaited basketry. To keep consistency in textile structure, I will build on the work of Irene Emery, a textile theorist, Mary Black, a Canadian weaver, and Shereen LaPlantz’s

and Virginia Harvey's bi-axial and triaxial weaving techniques to begin developing triaxial bias plaited theory.

Irene Emery's (2009) book, *The Primary Structures of Fabrics: An Illustrated Classification*, develops textile structure categories and patterning for single and bi-axial construction of textiles. Keeping consistent structures moving from bi-axial to triaxial textiles begins the process of developing triaxial structural theory.

Mary Black's (1980) book, *The Key to Weaving: A Textbook of Hand Weaving for the Beginning Weaver*, takes one from the beginning of learning to weave through to multi-harness patterns. Although this book is not about basketry, Black's writing about weaving patterns, plain weave and twills is clear and is transferable to basketry patterns and techniques.

Basket makers and writers, Shereen LaPlantz (1991) and Virginia Harvey ([1984] 2005) cover bi-axial and triaxial basketry; however, their focus is on technique and not on developing triaxial theory and structure. Starting with their approaches to weaving techniques will assist in understanding the theory and structure of triaxial basketry.

Triaxial Bias Plaiting Basketry Techniques

There are two main techniques that I have found in searching the literature to construct triaxial bias plaited basketry. Each method has advantages and disadvantages, based on the type and composition of weaving strips, the triaxial basket style and shape, and the preference of the basket maker.

LaPlantz Method

The LaPlantz Method of triaxial weaving technique is derived from her book *The Mad Weave Book: An Ancient Form of Triaxial Basket Weaving*. ([1984] 2005). Shereen LaPlantz builds her baskets by laying down the base strips one direction at a time and weaves the strips through the layers.

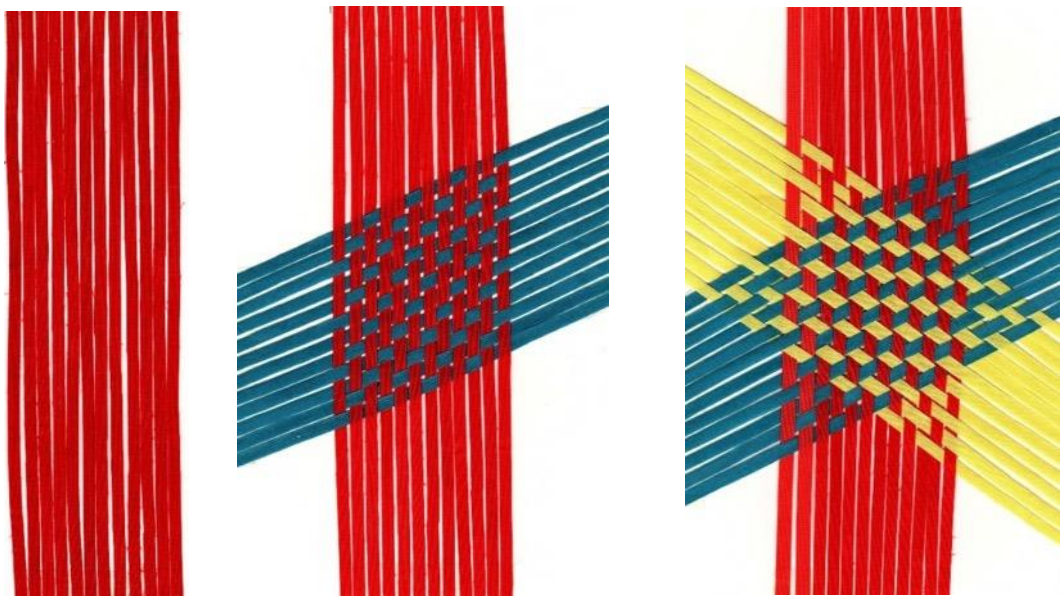


Figure 4. LaPlantz Base Start Method. Demonstration by Susan Brunton.

Middle Start Method

In Virginia Harvey's *The Techniques of Basketry* and Glashausser and Westfall's *Plaiting Step by Step*, the authors start the triaxial base in the middle and adds strips on each side, turning the base with each stroke until it reaches the desired size.

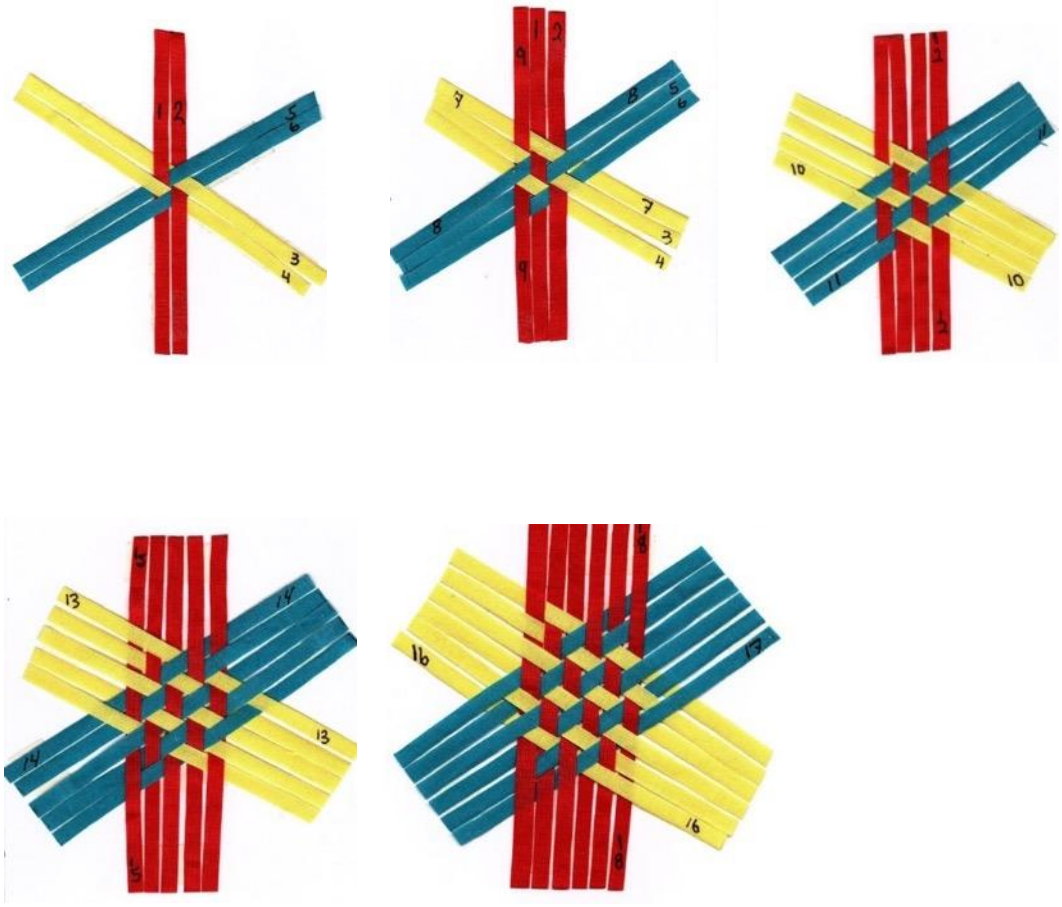


Figure 5. Middle Base Start Method. Demonstration by Susan Brunton.

Modern Makers of Triaxial Bias Plaited Basketry

Modern Contemporary Art Styles

In North America, Shereen LaPlantz is a well-known modern bi-axial triaxial basket weaver, teacher and writer. Unfortunately, she is deceased. Being one of the few instructional volumes, LaPlantz's (2005) book focuses specifically on techniques and does not venture into any theoretical discussions. Her use of the term "Mad Weave," a translation from the Malay name of Anyam Gila, has popularized this term in modern triaxial weaving parlance. The notion that triaxial basketry is challenging to make and drives learners mad when trying to learn the technique, has discouraged many from trying this plaiting style of basketry.

Dorothy McGuinness specializes in bi-axial diagonal twill basketry. Using watercolour paper she colours with acrylic paints then cuts her weaving strips with a pasta-making machine. On her website, McGuinness has a section called Mad Weave where she has pictures of triaxial baskets she has made; however, there is no discussion regarding technique, nor is there any distinction between bias and non-bias triaxial weaving or theory (McGuinnas 2012).

I regularly search for triaxial basket makers, looking for new names and baskets to add to my library. Anytime I find a new triaxial basket maker or picture, it is a surprise, and I gratefully add it to my studio library.

Basket Associations, Groups and Guilds

I am adding Basket associations, groups, and guilds to this literature review because these groups are important to basket and weaving communities. Around the world basket makers and people who are interested in basket making have formed many associations, guilds and groups of informal and formal membership that offer modern makers support, education, sharing of skills, libraries of basketry and weaving books and the opportunity to interact with makers near and far away.

The National Basketry Organization (NBO), from Gloucester, Massachusetts in the United States of America is an example of a large organization with international reach. Active on social media, NBO is a non-profit organization providing fellowship and education while increasing awareness of the breadth and scope of basketry. It offers publications, and a website, also creating and sponsoring exhibitions and conferences.

Traditional Styles and Modern Adaptations of Triaxial Bias Plaited Basketry

In Malaysia, N.H. Ismail writes, “that plaiting began in the Neolithic age and weavers still create the art from long ago” (Ismail 2013). Today there

are few Malaysian traditional triaxial bias plaited basket makers still practising. Using undyed, hand prepared Pandanus leaves weaving strips are made to plait traditional triaxial baskets known as Anyam Gila (Mad Weave) (Sentance 2001). Pandanus based baskets are vulnerable to extinction as many Pandanus plants have been lost due to the development and planting of palm oil plantations (Santos 2008).

Traditional triaxial basket makers struggle to live in balance with their environment. Pandanus plants are needed to supply the raw materials to process the thin and flexible strips needed to plait traditional triaxial basketry. The basket makers must take only what they need and only what a plant can spare, often not providing enough weaving strips to make the baskets (Sentance 2001).

Because traditional basket makers using hand gathered and produced plaiting materials work closely with nature, they are cognizant of environmental changes. As a direct consequence of climate change, pollution, and change in land use, traditional triaxial basket makers must constantly adapt their working methods to keep Pandanus craft alive (Sentance 2001).

In addition to the scarce availability of Pandanus plants, modern-day makers struggle to maintain and preserve their ancient skills (Rahim 2012). The amount of time needed to harvest, prepare, process and make

weaving strips takes longer than weaving the basket. With the availability of cheap plastic containers, the art of Pandanus weaving (Anyam Gila) is now on the wane (Rahim 2012). This basketry technique has traditionally been passed from generation to generation through the oral tradition. However, the technique will die out if new weavers do not come along. Traditional bias triaxial basket weaving is threatened with extinction (Ismail and Nawawi 2011).

It is difficult to know how much basket technology has passed into disuse and therefore disappeared. In Malaysia, the Gerimis Art Project and Gerai OA are volunteer organizations working to preserve Mad Weave and encourage new weavers to learn this type of basket making (Gerai OA 2004; Gerimis Art Project 2018). Capturing traditional knowledge, recording and collecting heritage baskets, preserving and protecting basketry and skills, market and business support for endangered basketry skills are all necessary for reviving and revitalizing traditional and basketry knowledge (Yap 2012).

It is vital to keep the body of knowledge built up around the ancient basketry technology alive through preserving the old ways. In addition, it is essential to enhance the technology by developing new techniques and designs to keep makers interested in triaxial weaving and bring new ideas to the techniques of triaxial bias plaited basketry.

Many of the same issues causing the endangerment of traditional basketry skills in Malaysia also threaten weaving and basketry traditions in other countries. The Convention for the Safeguarding of the Intangible Cultural Heritage on our planet through UNESCO reaches out to preserve endangered assets including more than weaving and basketry (UNESCO 2003). In the United Kingdom, the Endangered Baskets Report by The Basketmaker's Association (2020) outlines the endangerment and extinction of heritage baskets and recommends steps to be taken to preserve threatened baskets. Persistent apathy towards ancient basket technology will continue to lead to the loss of knowledge and skills as our environment decay heads to the point of no return.

Mathematics and Triaxial Bias Plaited Basketry

Triaxial Bias Plaiting in the Mathematics Classroom

Mathematician, teacher and weaver Louise Gould's article, *Baskets for the Mathematics Classroom,* is a lesson plan for teachers who want to provide enrichment to their advanced mathematics students (Gould). Although intended as a lesson plan, the article provides instruction for making bi-axial bias baskets and triaxial bias baskets as well as a discussion of the mathematics embedded in their making that is useful for basket makers.

MathWeave

Mathweave is a research group investigating the relationship between mathematics and art from an educational perspective, focusing on the use of mathematics in textiles. This research group consists of Eva Knoll, Wendy Landry, Tara Taylor, Paul Carreiro and Katie Puxley. The group uses Making With Rigour as a research methodology to explore and investigate the mathematical thinking in the design, creation, and appreciation of artifacts. (Knoll, Landry,Taylor, Carreiro 2012). I use this methodology in the research and development of the colour and weave theory and techniques demonstrated in the experimental chapter of this thesis.

Adapting Making with Rigour as a research methodology for this thesis I focus on asking probing questions aimed to uncover what is happening in the interaction of colour and weave elements of triaxial bias plaited basketry; for example, what is the path traveled by the individual plaiting strips in a complete circuit around the basket? How do the strips interact with each other as a structural element? How does the colour of multiple strips work together? What are the technical restraints in the process of making triaxial bias plaited basketry?

Making with Rigour uses mathematics as a way of thinking, utilizing visualization, problem-solving, shapes, and rhythmic colour placement of

weaving strips. Using advanced weaving knowledge to dissect and reconfigure the colour and weave issues for triaxial bias plaited basketry, combined with the Making with Rigour tools from the MathWeave research group, led to the development of new colour and weave theory and techniques.

The Genesis of This Research Into Colour and Weave Interaction in Triaxial Bias Plaited Basketry

Paul Gailiunas is a mathematician with an interest in triaxial basketry. Gailiunas has written three articles looking at triaxial weaving and mathematics and has presented them at the Bridges Organization Conference, a gathering to foster research, practice, and new interest in mathematical connections to art, music, architecture, and culture (Gailiunas 2011; 2013; 2017).

Paul Gailiunas in his article *A Mad Weave Tetrahedron* (2011, p. 39**)** states: “There does not seem to be any theory that relates the sequence of colours in the elements to the appearance of the resulting pattern…”

My examination of the existing literature agrees with Gailiunas's opinion that no colour theory or colour sequence patterning exists in the current literature about triaxial bias plaited basketry. Gailiunas is correct in his view that little information exists in the literature regarding colour theory in

triaxial weaving, and this gap in the literature is part of the basis of my thesis research.

The same author writes in *Patterns for a Skew Weave Polyhedra***:**

> The structure must be modified to produce corners if anything more than a flat piece of basketry is required, but strands change direction at a corner, so that in general colour sequences are not preserved and a regular pattern would be disrupted….Basket-makers seem to accept this….(Gailiunas 2013, p16)

I disagree with his view that basket weavers have to accept colour pattern disruption at the corner turnup of triaxial baskets. The ability of weavers to control colour placement in their work is a necessary and fundamental skill in the colour and weave technique in weaving theory. The original research conducted for this thesis develops strategies in colour and weave techniques to give basket makers control over colour pattern placement, allowing makers to add colour design to triaxial bias woven basketry.

Summary

Basketry technology is ancient, developed early in human evolution studied today by archaeologists and anthropologists as material culture. Specific basket techniques, construction methods, materials used, and designs reflect aspects of many and various systems of knowledge,

cultures, human history, tradition, and spirituality. Baskets are still used today as utility items or artistic and/or cultural objects.

Unfortunately, many traditional baskets made for specific tasks are endangered or extinct. The extinction of ancient weaving technology erodes the foundation of basket making knowledge rendering future generations void of critical skills. The loss of this technological knowledge developed over human history and civilization formed by makers who lived in balance with the natural environment and returned to nature the elements harvested at the end of the useful period of the basket is detrimental to the future of our species. Rather than allowing old technology to succumb to extinction, we should embrace the skills used over the millennia to reverse the destruction modern humans have done to our planet.

My research seeks to reverse the endangerment of triaxial bias plaited basket technology through developing essential new knowledge and colour and weave techniques to assist in modernizing the appeal of this style of basketry, and to encourage present and future weavers to grow the design of modern triaxial bias plaited basketry while striving to live in balance with our natural environment.

Chapter Three

MathWeave - Making with Rigour: A Methodology

Research in basket making is a process requiring a series of questions, decisions and choices made along the journey to produce a finished basket. I research the weaving theory and mathematical constructs present in the under-structure of triaxial bias plaiting in two- and three-dimensional construction. I use the MathWeave group's methodology, Making with Rigour, created by five researchers, makers, mathematicians, and weavers from the east coast of Canada to research colour and weave techniques in triaxial bias plaited basketry. (Knoll, Landry, Taylor, Carreiro, Puxley 2012).

They used practice-based methodology, mathematical thinking and inductive mathematical theory to conceive *Making with Rigour: MathWeave*, a mathematical problem solving, evidence-based approach to research-creation. This is a way of looking at things by stripping a problem, in this case a basket, down to its essential elements, and then analysing the underlying patterns to derive solutions. Mathematical thinking is more than arithmetic; it is critical thinking and problem-solving skills used in mathematics to engage in complex problem solving necessary to uncover the underlying issues and facts, turning these issues to conclusions and solutions. Reverse engineering is used to take apart

the structure of the corner element configuration, then analyze the critical path to gain colour control over structural patterning.

This is a systematic and thorough search using probing questions to deconstruct the problem down to its components, moving from how something is made to what are the basic, structural, and formal principles acting to build the woven elements in question. Analysis of the basic structure is undertaken by uncovering what path the individual elements take in weaving the basket and how these elements relate to each other.

This methodology uses critical thinking as adapted from the Math Weave group's Making With Rigour, using a mathematical problem solving approach to first identify the problems, then observation and analysis to draw inferences leading to solutions to the problems. Each step in the methodology moves from questions to observations to solutions as each step is made through the process of deconstruction through to the completion of the experimental basket with the desired pattern on the walls of the basket. The Math Weave group's methodology of Making With Rigour guides, in this thesis, a weaving researcher to systematically design a study that lays out the logical steps to uncover and frame the critical research issue and develop the strategy to yield valid and reliable results.

The following is the structural and theoretical development of the research methodology which forms the basis for the research procedure. All weaving done for this thesis uses 100% cotton fabric coated with a glue-based stabilizer and cut into strips using a leather stripper tool.

Structural Components of Triaxial Bias Plaited Basketry

Terminology

Plaiting is a basketry term that refers to weaving elements that are thin, pliable and of similar size and dimension. Woven and plaited strips plus weaving elements are terms used interchangeably to describe the construction elements used in triaxial weaving.

Design Tools

Triaxial Colour Order Design Mat

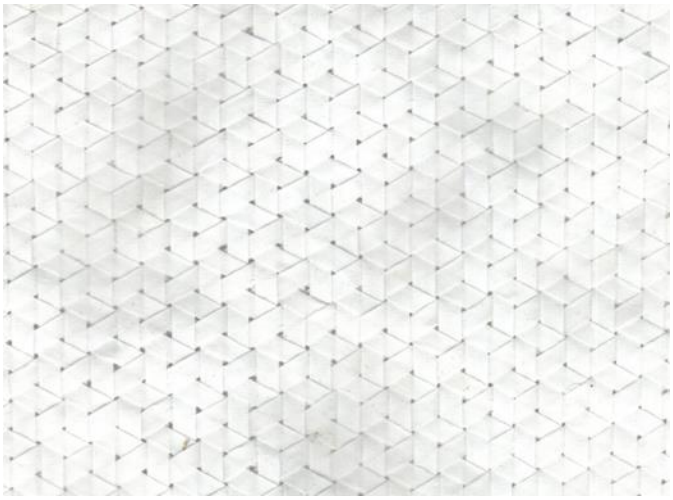


Figure 6. Triaxial Colour Order Design Mat. Source Susan Brunton.

The Triaxial Colour Order Design Mat is woven with white cotton fabric strips in the triaxial structural pattern of Tumbling Blocks. I designed this mat to use to explore colour patterns by inlaying various colour strips before committing to colour placement when weaving a basket or flat triaxial fabric.

When researching and experimenting with triaxial bias plaiting it is crucial to realize that the structural pattern, as demonstrated above in the design mat, is the foundational woven structure known as Tumbling Blocks and does not change when weaving triaxial bias plaiting.

Triaxial weaving has other structural patterns that have not been studied or named at the time of writing this thesis therefore they are not examined in this research.

Deconstruction of the Triaxial Bias Plaiting Basketry Structure

Description of Triaxial Bias Woven Structure

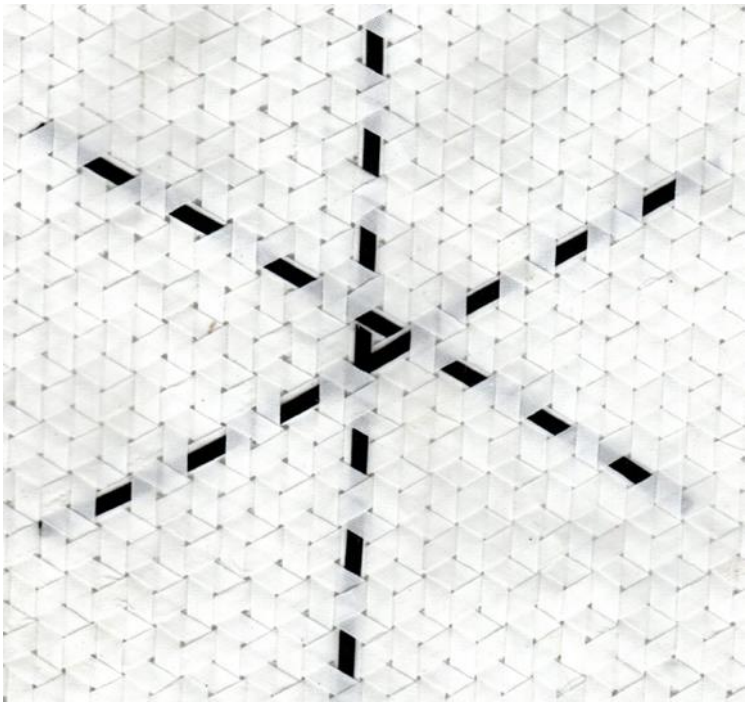


Figure 7. A Single Triaxial Weaving Stroke. Demonstration Susan Brunton.

The three black weaving strips above show the direction and placement of the three weaving elements used to construct triaxial plaiting. A single complete action using three strips to weave a triaxial pattern is called a stroke. Examination of the direction taken by each weaving strip shows twill structural pattern development, intersecting three levels of triaxial woven strips.

Triaxial bias plaiting is a hexagonal weave structure using three strips woven sixty degrees from each other as they enter the web. For this thesis the triaxial weaving elements are woven closely together producing a closed triaxial structure with a surface of cubes showing tiny holes at points of intersection in the web.

Interaction of Structural and Colour Pattern in Triaxial Weaving Theory

Triaxial bias plaited basketry requires the examination of structural and colour pattern simultaneously to build baskets. Tumbling blocks is the structural pattern used in all weaving done for this thesis. The face of the structural weaving pattern on flat or three dimensional triaxial weaving is a repetitive series of small cubes. This patterning results from three weaving elements entering the web at sixty degrees from each other.

The colour of each weaving strip does not impact the structure of triaxial plaiting. If all colour is removed from the weaving strips used in this thesis the structural pattern of repeating cubes remains unchanged. Despite the function of colour to develop pattern on the face of triaxial weaving, adding colour to the weavers is not a structural component.

Bias Weaving Characteristics of Triaxial Bias Plaited Basketry

All elements needed to weave the triaxial bias basket are laid out in the base. Triaxial plaiting requires three sets of weaving strips woven at sixty

degrees from each other as they enter the web. All weaving strips are either vertical, right or left diagonal.

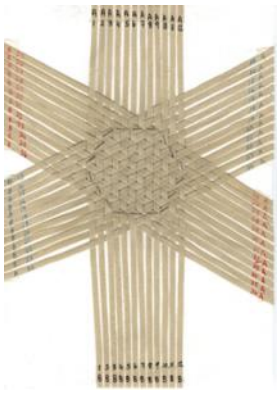
Basket Shape

The shape of a triaxial bias plaited basket is determined by the base shape used to build the corners on a basket. The corners, created to build the wall of the basket, are woven with existing strips in the plaited base.

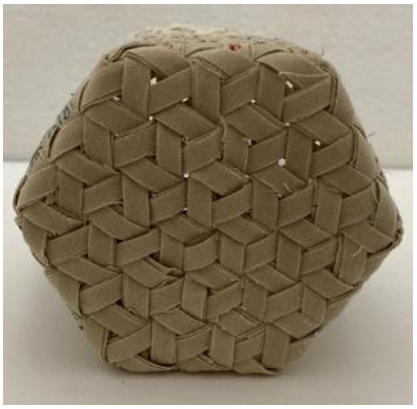
Basket Corners

In this thesis bases of six, five, four and three corners that are turned up to create the basket sides are used to create the experimental baskets.

Six Sided Basket



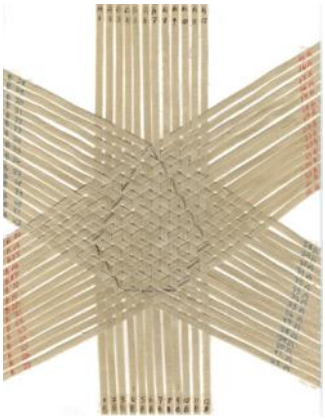
Basket Base



Basket Bottom – Six Corners

Figure 8. Six Sided Basket Base and Bottom. Source Susan Brunton.

Five Sided Basket

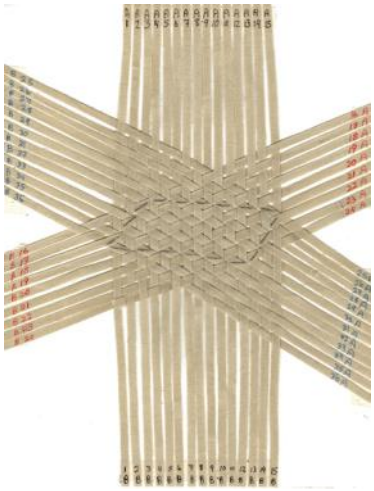


Basket Base

Basket Bottom – Five Corners

Figure 9. Five Sided Basket Base and Bottom. Source Susan Brunton.

Four Sided Basket

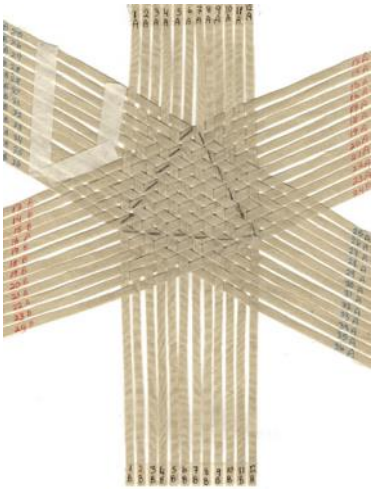


Basket Base

Basket Bottom – Four Corners

Figure 10. Four Sided Basket Base and Bottom. Source Susan Brunton.

Three Sided Basket



Basket Base

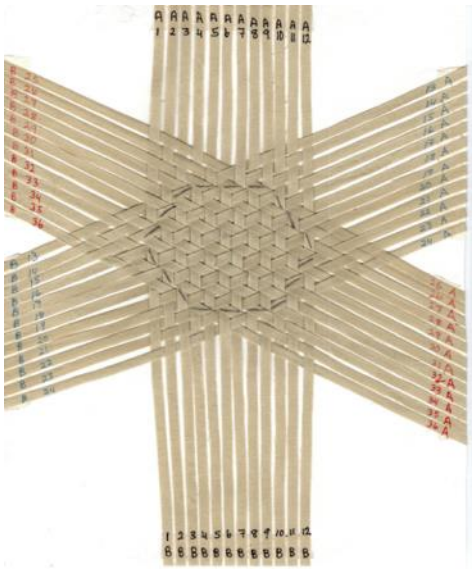
Basket Base – Three Corners

Figure 11. Three Sided Basket Base and Bottom. Source Susan Brunton.

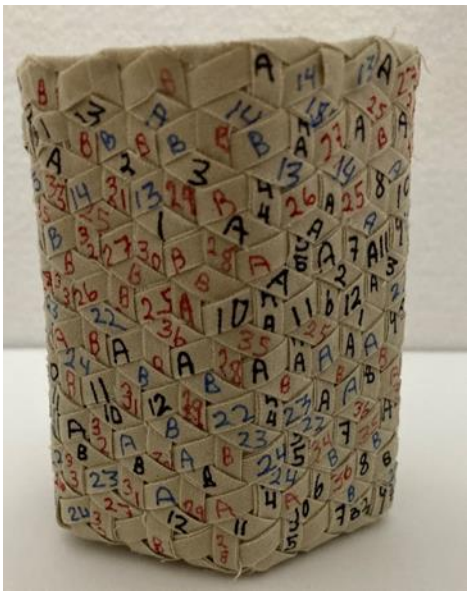
Number and Position Designation on Each Weaving Strip

On the basket base each weaving element is numbered, and each strip is designated as A (top) or B (bottom). I developed this numbering system to facilitate the tracking of each strip as it is woven into the basket. By assigning a number and position to each weaving strip, properties are explored through the patterns that emerge through paths and relationships.

Six Sided Basket with Directional Markings on Basket Wall



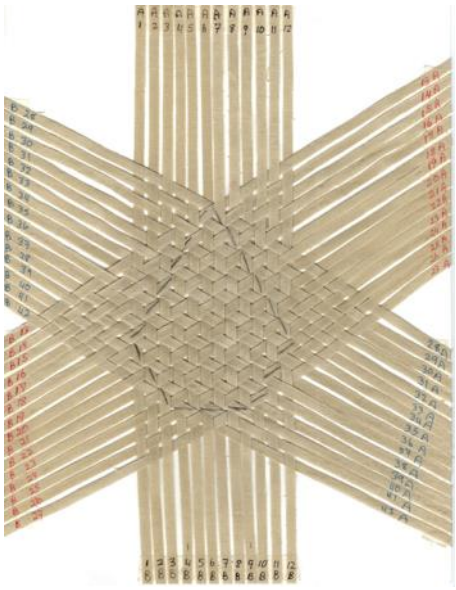
Basket Base – Six Corners



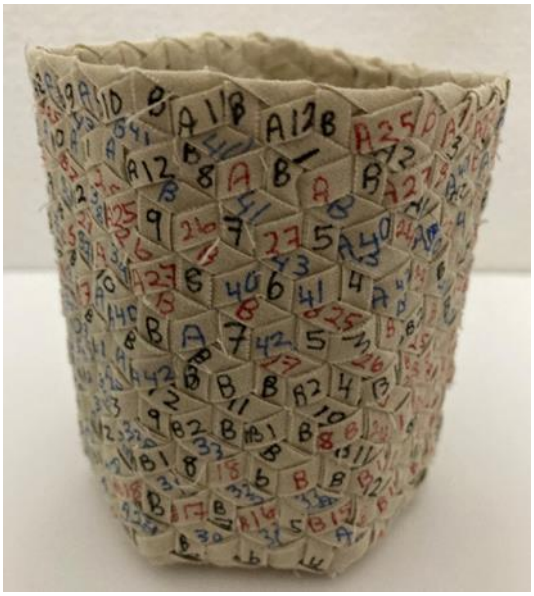
Basket Wall with Directional Marking

Figure 12. Six Sided Basket with Directional Markings. Source Susan Brunton.

Five Sided Basket with Directional Markings



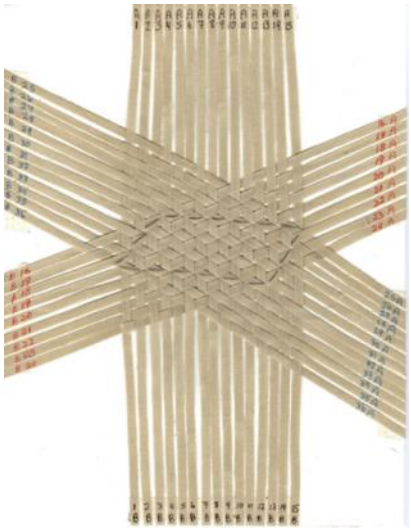
Basket Base – Five Corners



Basket Wall with Directional Markings

Figure 13. Five Sided Basket with Directional Markings. Source Susan Brunton.

Four Sided Basket with Directional Markings



Basket Base – Four Corners

Basket Wall with Directional Marking

Figure 14. Four Sided Basket with Directional Markings. Source Susan Brunton.

Three Sided Basket with Directional Markings

Basket Base – Three Corners Basket Wall with Directional Markings

Figure 15. Three Sided Basket with Directional Markings. Source Susan Brunton.

Deconstruction of Triaxial Structural and Colour Positions

Patterns

Colour pattern on the base of the basket and a different colour pattern on the wall of the basket illustrates the anomaly that occurs when turning the base weavers up at the corners to form the basket walls. This action of the anomaly is a key point of analysis for this research.

Deconstruction of the Basket Corners

The shape of each basket is outlined on the basket base and the circled area on each base shows the corner configuration.

Six Element Base with Corner Markings

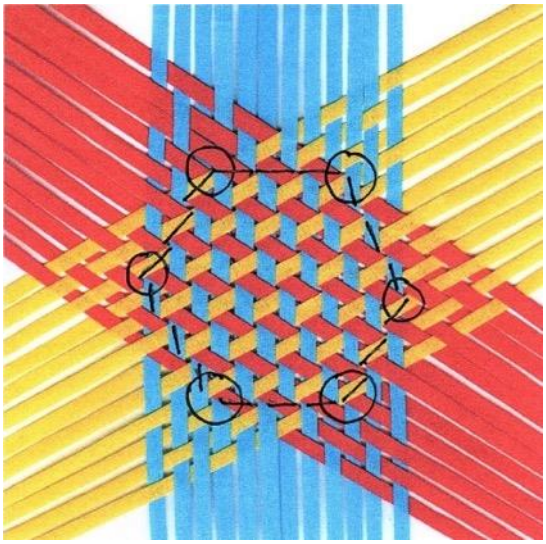


Figure 16. Six Element Base with Corner Markings. Source Susan Brunton.

Five Element Base with Corner Markings

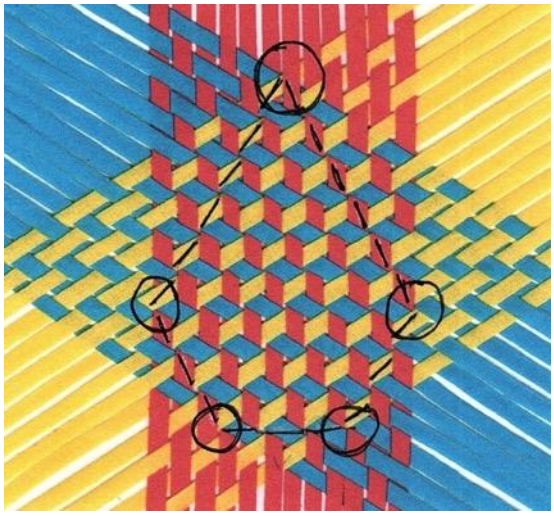


Figure 17. Five Element Base with Corner Markings. Source Susan Brunton.

Four Element Base with Corner Markings

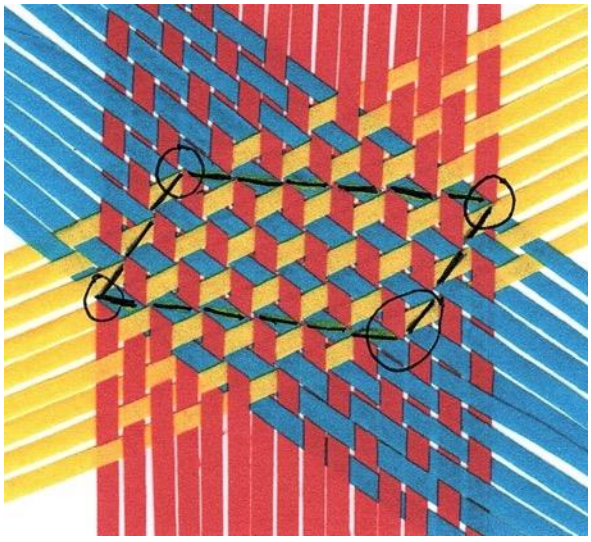


Figure 18. Four Element Base with Corner Markings. Source Susan Brunton.

Three Element Base with Corner Markings

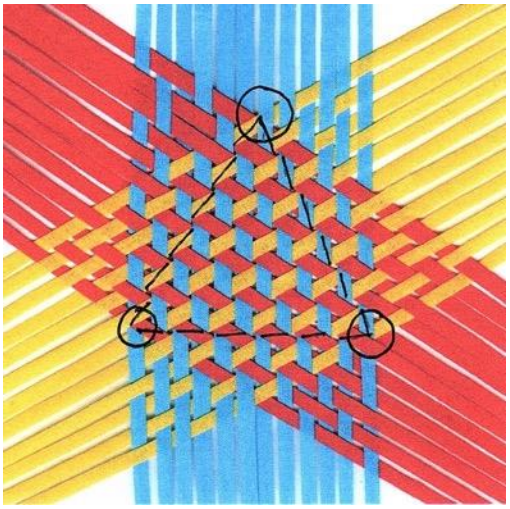


Figure 19. Three Element Base with Corner Markings. Source Susan Brunton.

Deconstructing the Basket Corner Turn Up Technique

In this thesis five element and four element corner turn up techniques are used to move the corner strips up to construct the sample baskets sides.

The five element corner turn up used to form the six sided basket uses the corner turn up technique six times to move the weaving elements at all six corners into the upright wall position. The structural woven configuration is demarcated using the inlay of beige strips and each strip position is written in black numbers, (fig.20). All six corner base turn up elements are woven using the same structure. Each turn up element is shown from the base, through the turn up and into the wall. The green basket does not have a colour patterning effect as only one colour is used in weaving. The three colour basket shows the Tumbling Blocks colour pattern on the bottom of the basket, however as the three colours weave through the corner turnup the colour pattern changes due to the structural position of the weaving elements.

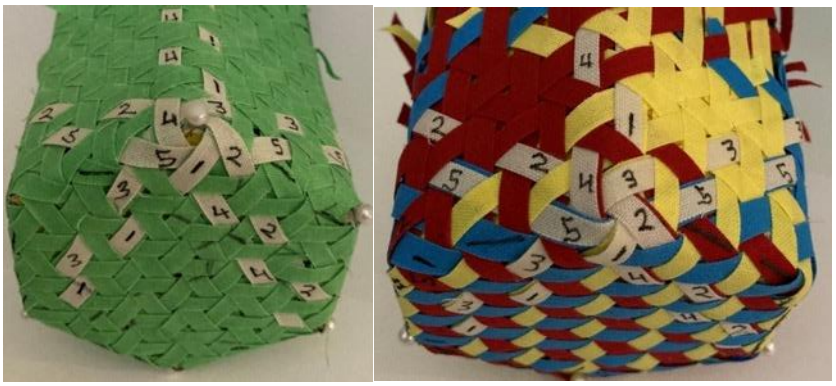


Figure 20. Five Element Corner Turn Up. Source Susan Brunton.

The four element corner turn up of weaving elements creates a tight, acute angle pulling all weaving elements to the basket walls. As with the five element corner the one colour basket shows no change in appearance however the three colour basket shows the dispersion of colour pattern from the basket base to the basket wall.

Four Element Corner Turn Up

Figure 21. Four Element Corner Turn Up. Source Susan Brunton.

Uncovering the Structural Pattern Anomaly that Deflects Colour

Structural Analysis

For the six sided triaxial basket, the corner is produced by turning up five weaving strips from the flat woven base corner which results in the corner strips moving into a vertical position. After all corners are moved to the vertical position the weaving strips are in place to weave the basket walls producing a basket wall face of triaxial cubes.

Deconstruction of the Path Taken by Colour Weaving Strips

The colours used to weave this basket base highlight the structural Tumbling Block pattern as each direction of the plaiting strips is a different colour.

Three Colour Basket Base

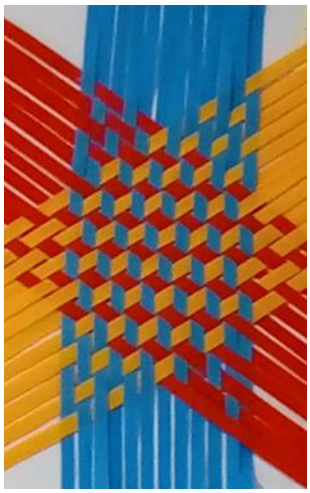


Figure 22. Three Colour Basket Base. Source Susan Brunton.

Colour and Weave Anomaly in Triaxial Bias Plaited Basketry

The basket bottom, woven from the basket base fig. 23 shows the Tumbling Block colour pattern. This six sided basket has six corners where five weaving elements are woven together to pull the weaving strips up to form the basket walls.

The shift in the colour pattern after weaving the corners clearly shows the anomaly in the disruption of the Tumbling Block colour pattern on the basket wall. This anomaly occurs for most colour patterns woven with the triaxial bias woven basket structure.

Three Colour Basket Base Three Colour Basket Wall

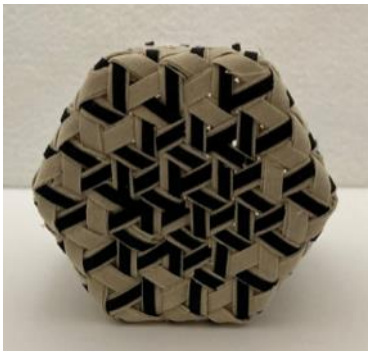
Figure 23. Three Colour Basket Base and Wall. Source Susan Brunton.

Deconstruct the Path of the Coloured Weaving Strips

The black strips show the position of vertical weaving elements as they are woven into the basket. The other weaving strips on either side of the basket are right or left diagonal strips. The path of the weaving strips are shown on the basket bottom as they turn up at the corner and weave into the basket wall.

Six Corner Base and Basket

Basket Base - Six Corners

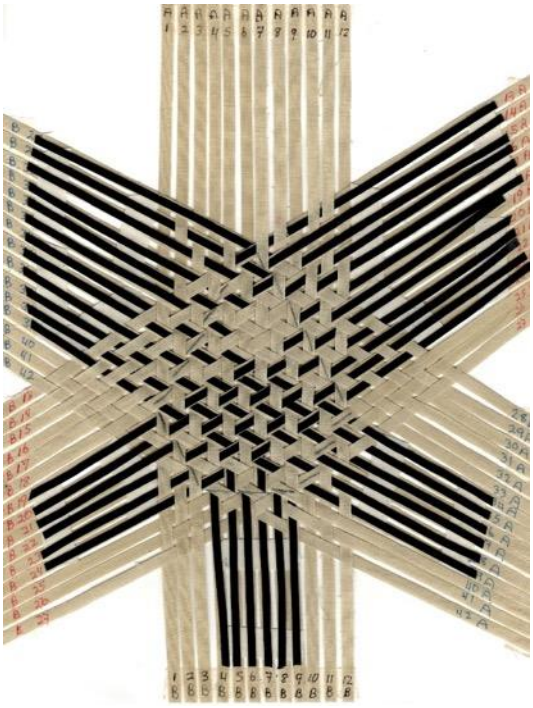


Basket Bottom

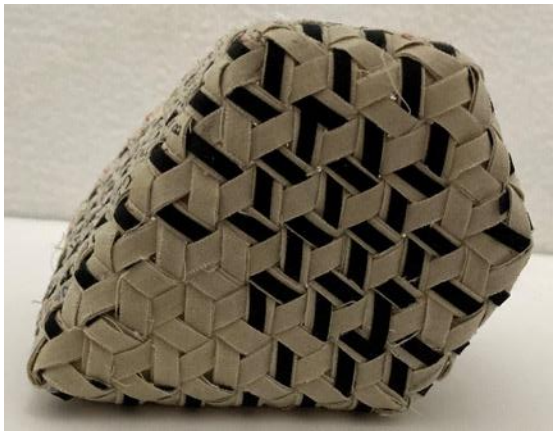
Basket Wall

Figure 24. Six Corner Basket Base, Bottom and Wall. Source Susan Brunton.

Five Corner Base and Basket



Basket Base - Five Corners

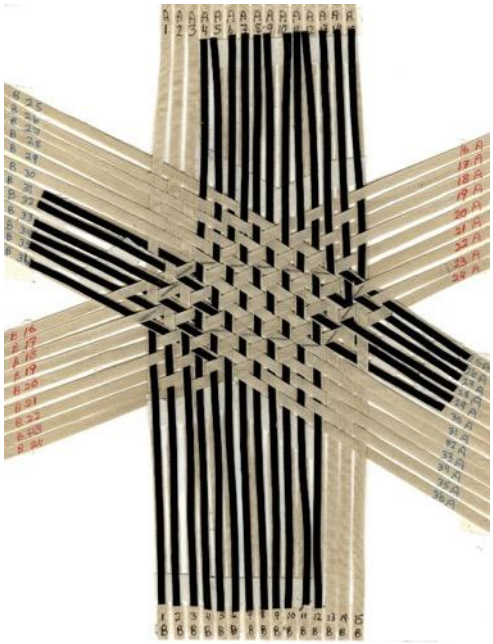


Basket Bottom

Basket Wall

Figure 25. Five Corner Basket Base, Bottom and Wall. Susan Brunton.

Four Corner Base and Basket



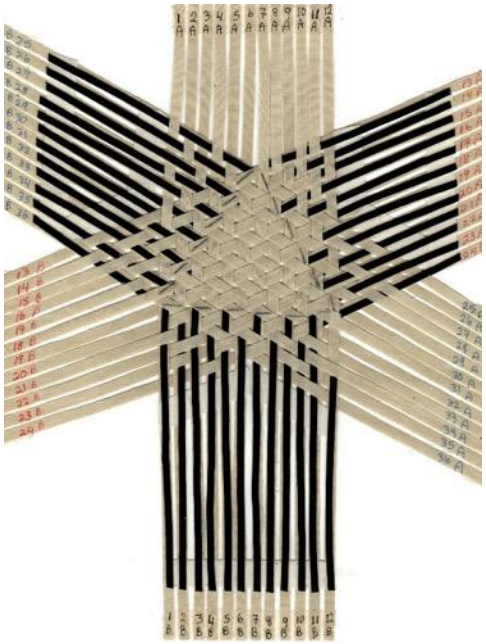
Basket Base – Four Corners

Basket Bottom

Basket Wall

Figure 26 . Four Corner Basket Base, Bottom and Wall. Source Susan Brunton.

Three Corner Base and Basket



Basket Base – Three Corners

Basket Bottom

Basket Wall

Figure 27 Three Corner Basket Base, Bottom and Wall. Source Susan Brunton.

The Path of Each Woven Strip

In triaxial bias plaited basketry each weaving strip, when viewed from the top of the basket, travels down, either in vertical, left diagonal or right diagonal position to the basket base. Then the weaving strip moves across the base, and then up the other side.

The path of each weaver is different when the base structure changes from six sides to five, four or three basket sides.

As each strip is woven into place its place number and location letter are written on each strip so the route taken by each strip can be examined.

Deconstruct the Place and Cause of the Colour Pattern Anomaly

Through observation and plotting the number and position of each weaving strip one can conclude that each strip holds a position on two basket sides and in the basket bottom. Thus the structural pattern of each weaver holds a place in the colour pattern on 2 different basket walls and this structural characteristic of the bias pattern is the cause of the colour pattern anomaly that causes the colour pattern shift past the corner on the basket wall.

Developing the Basket for Colour and Weave Effect Pattern Planning

Using the same concept from the Triaxial Colour Order Design Mat single colour baskets for the four basket shapes were woven and marked with

the number and position of each weaving strip. Using the desired colour weaving strip to plan the colour pattern on the face of the basket each strip is inlaid in the chosen position to build up the colour pattern. For this step in the colour pattern development each triaxial bias weaving strip is to be considered two strips as if A and B ends of each strip is independent in the weaving process.

Basket for Colour and Weave Effect Pattern Planning

Figure 28. Basket for Colour and Weave Effect Pattern Planning. Source Susan Brunton.

Colour Adjusted Weaving Strips to Control Pattern on Basket Walls

The research design anomaly and weaving techniques to adjust the corner up turn are in place after establishing the colour of each weaving strip,

then the A and B section of each strip are glued together creating one weaving strip, then the colour adjusted strips are woven into the basket base. When the colour corrected base is woven the desired colour pattern will appear on the basket wall. The baskets woven with the colour corrected base will have the desired colour pattern on the basket wall.

Experimental Research Design

The experimental research design developed for this thesis accomplishes the following tasks in a series of contingent steps laid out in the steps of the methodology.

1. Sort which colour patterns need to be adjusted to place the planned colour pattern from the bottom of the basket to the basket wall.
2. Using the Basket for Colour and Weave Effect Planning, the composition and placement of the adjusted colour strips are created.
3. The original and the colour adjusted patterns can be entered into the maker's library of plaiting patterns ready for future use.

The steps taken in the research methodology led to the development of the experimental research design framework used for each triaxial bias plaited colour pattern.

Experimental Research Design Framework

Basket Shape -

Structural Pattern Name -

Colour Pattern Name – Tumbling Blocks

Step 1

Using the Triaxial Colour Order Design Mat**, (**tool #1 developed for this research) plan out the colour and placement of each strip.

Step 2

Plait the base for the basket following the pattern and colour order planned on the Triaxial Colour Order Design Mat.

Step 3

Using the Tumbling Blocks basket base from Step 2, turn the basket corners and plait the basket walls using the double walled construction technique.

Step 4

Observation Analysis Question

Is the desired colour pattern on the basket walls?

Yes / No

If Yes; no adjustment to the colour pattern is required therefore the basket experiment is complete after Step 4.

If No; further adjustment of the colour pattern is required. Continue with Step 5.

Step 5

Numbering System for Colour Control and the Basket Base

Tool number 2 for this research.

Each plaiting strip is labeled with a number and letter (A or B) depending on its placement in the basket base.

Step 5 continued - Tool 3

Base Groups of Strips designated for basket base.

Step 6

Using tools 2 and 3, plait the Basket for Colour and Weave Effect Pattern Planning

Tool 4 developed for this research

Step 7

Using the Basket for Colour and Weave Effect Pattern Planning

Inlay the colour strips as per colour pattern.

Step 8

Adjusted Colour Pattern Strip Planner

Tool 5 developed for this research

Step 9

Adjusted Individual Colour Strip Planner

Tool 6 developed for this research

Step 10

Preparing the Colour Adjusted Plaiting Strips

Technique 9 developed for this research.

Plait the base and basket walls of the triaxial bias plaited colour adjusted basket

Step11

Results of the Colour Adjusted Research Process
End of research process.
Repeat for the next weaving pattern

This 11 step research process, derived through using the MathWeave Methodology technique of Making with Rigour is used to analyze and create the 52 experimental baskets woven for the thesis in Chapter 3.

Chapter Four

Experimental Research Results

The research procedure was designed for this thesis to accomplish two goals:

1. To determine if the colour pattern on the basket base and basket side is the same.
2. To develop colour element placement to move the desired colour pattern from the basket bottom to the basket sides.

Seven colour patterns were analyzed through the eleven-step research procedure developed in the Methodology Chapter. They are: Tumbling Blocks, Framed Star, Cubes Three Colours, Cube Rose, Pinwheel, Row of Purple Flowers and ZZZ. For each colour pattern, experimental triaxial bias plaited baskets, varying in base size from three to four inches and three to four colours, repeats in the basket's height were plaited. The first experimental basket shows the original colour pattern on the base, after analysis, if adjustment in colour placement needs to be done the second experimental basket shows the adjusted colour pattern placement determined in the research process on the basket wall. The experimental basket shown in step three is used in the Observation Analysis in step four of the research procedure if the desired colour pattern is on the basket wall. For each colour pattern four basket shapes with six, five four and three basket sides are woven. A total of 52 experimental baskets were woven for this thesis.

One colour pattern, The Framed Star, was shown to have the same colour pattern on the basket base and the basket walls in step four, therefore no further colour placement adjustment was necessary. The same result was shown through all four basket shapes indicating the colour and weave effect in the Framed Star Pattern does not require adjustment.

The final basket results are shown below.

The first basket analyzed for this thesis sets out the experimental method and guides the weaver through the steps and decisions required to fulfill the experimental process. All other colour patterns analyzed for this thesis are presented below showing the original colour basket and, if required, the colour adjusted final basket.

Experimental Research Results

The colour pattern Tumbling Blocks, six sides, is the first pattern analyzed for this research. The research process is taken step-by-step to illustrate how to navigate the experimental path.

Experimental Research Process

Basket shape: 6 sides

Basket Structural Pattern: Tumbling Blocks

Basket Colour Pattern Name: Tumbling Blocks

Step 1

Using the **Triaxial Colour Order Design Mat, (**tool #1 developed for this research) plan out the colour and placement of each strip. Colour Pattern Name: Tumbling Blocks.

Triaxial Colour Order Design Mat

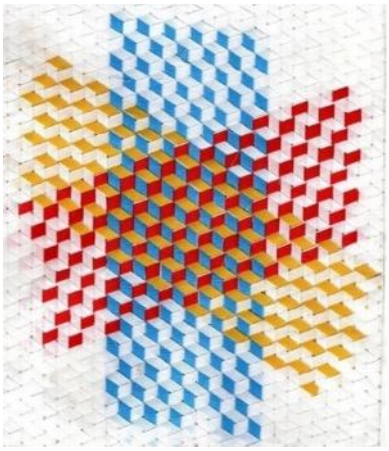


Figure 29. Triaxial Colour Order Design Mat. Source. Source Susan Brunton.

Step 2

Plait the base for the Tumbling Blocks basket following the pattern and colour order planned on the **Triaxial Colour Order Design Mat.**

Base of Triaxial Bias Plaited Basket

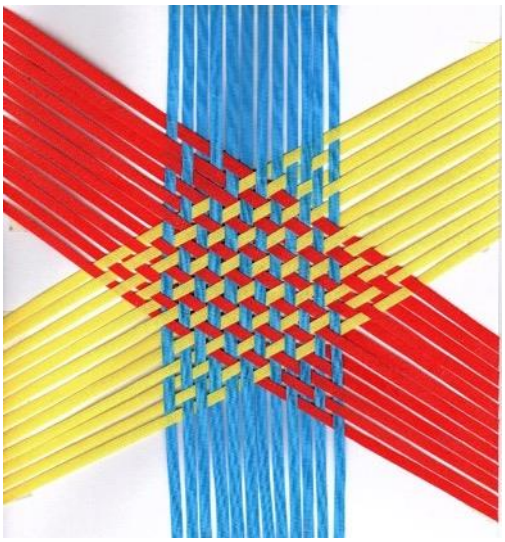


Figure 30. Base of Triaxial Bias Plaited Basket. Source Susan Brunton.

Step 3

Using the Tumbling Blocks basket base from step 2, plait the basket walls using the double wall construction technique.

Basket Walls Not Tumbling Blocks	Basket Base Tumbling Blocks

Figure 31. Basket Base and Wall - Three Colours. Source Susan Brunton.

Step 4

Observation Analysis Question

Is the desired colour pattern on the basket walls?

No, the Tumbling Blocks Colour Pattern is not on the basket walls.

Further adjustment of the colour pattern is required. Continue with Step 5.

Step 5

Numbering System for Colour Control and the Basket Base

Tool #2 for this research project

Each plaiting strip is labeled with a number and letter (A or B) depending on its placement in the basket base.

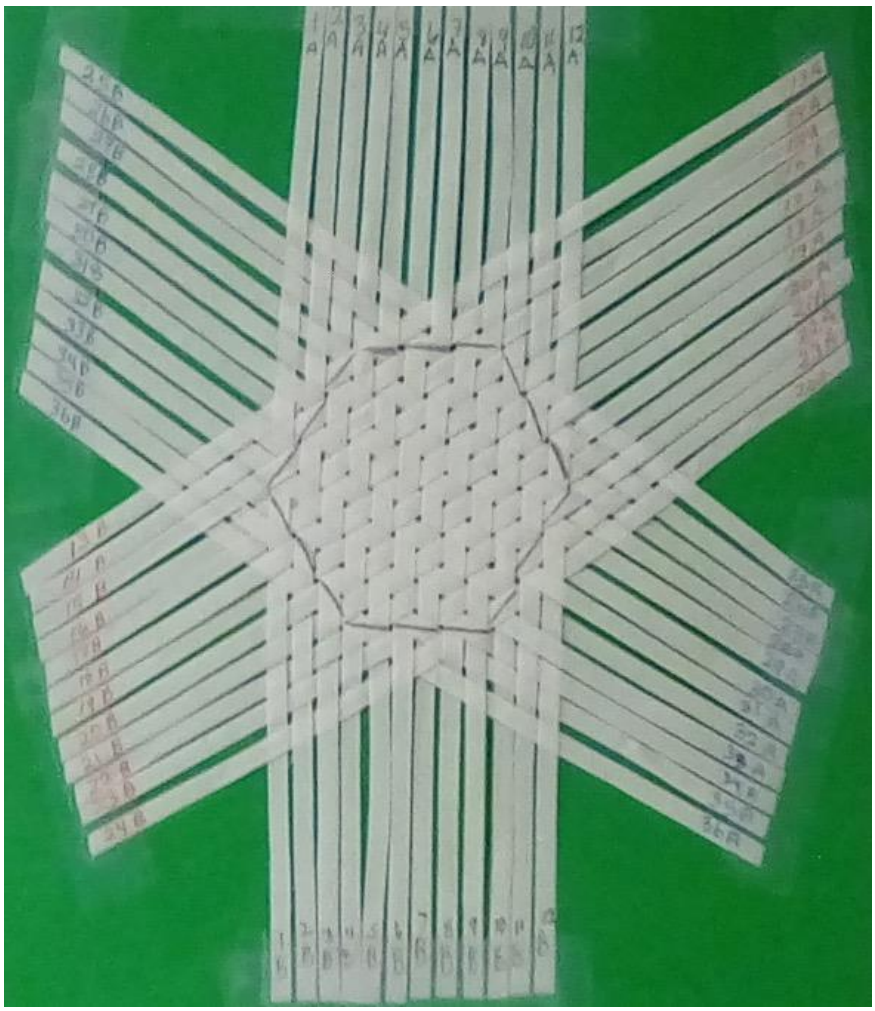


Figure 32. Numbering System for Colour Control and Basket Base. Source Susan Brunton.

Step 5 Continued

Base Groups of Plaiting Strips

Tool 3 developed for this research

Vertical Strips 1 to 12 A and B

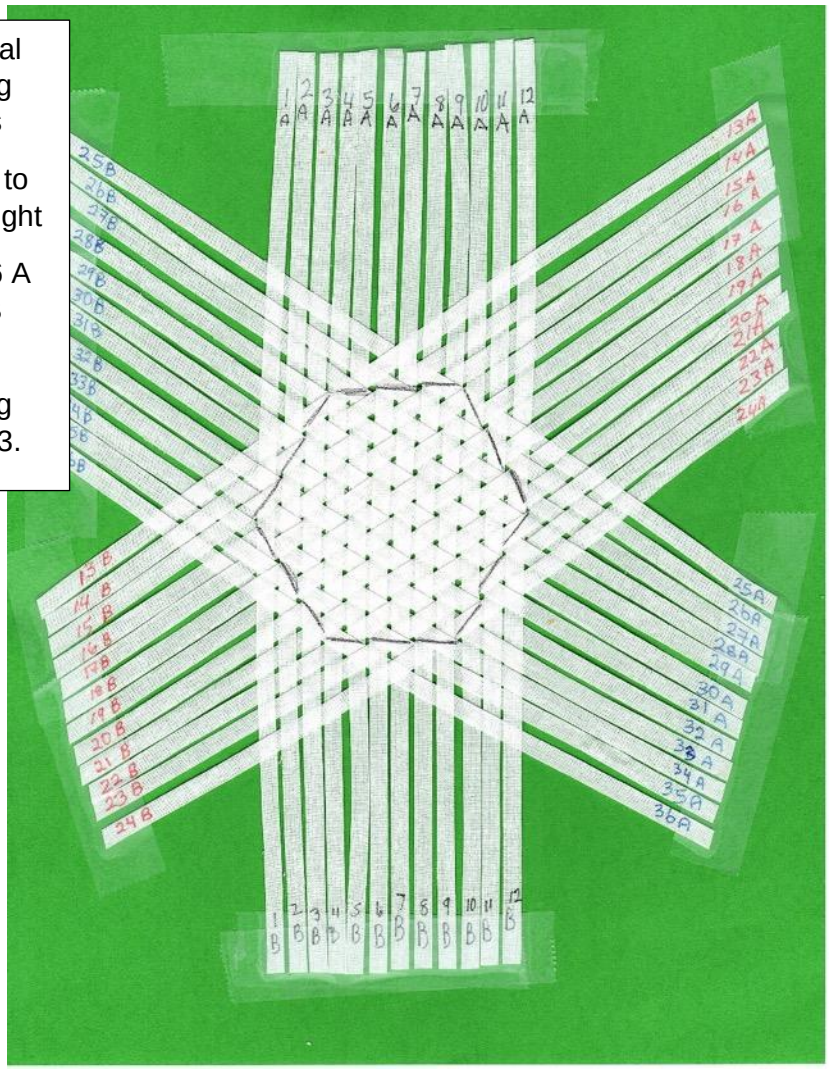
Base Strip Group 1

Diagonal Plaiting Strips

top left to bottom right

25 to 36 A and B

Base Plaiting Group 3.



Diagonal Plaiting Strips

top right to bottom left

13 to 24

A and B

Base Strips Group 2.

Figure 33. Base Groups of Plaiting Strips. Source Susan Brunton.

Step 6

Basket for Colour and Weave Effect Pattern Planning. Tool 4 developed for this research.

Starting from the Basket Base with the Numbering System for Colour Control, turn the corners and plait the basket walls using the Double Wall Construction Technique.

The finished basket is called **Basket for Colour and Weave Effect Pattern Planning**. Number each weaving strip according to the number and letter found at the ends of each weaving strip. Place the numbers along the length of each weaving strip in the three directions using 3 different colours.

Basket for Colour and Weave Effect Pattern Planning

Figure 34. Basket for Colour and Weave Effect Pattern Planning. Source Susan Brunton.

Tools 2, 3, and 4 only need to be repeated when using a different base shape. The first basket shape in the experimental process is the six sided hexagon as seen above. A new **Basket for Colour and Weave Effect Pattern Planning** is needed for the 5, 4 and 3 sided baskets

Step 7

Using the Basket for Colour and Weave Effect Pattern Planning, inlay the appropriate colour of each strip to form the desired pattern on the walls of the basket. For the Tumbling Blocks Pattern each of the three directions of strips has different colours.

Basket for Colour and Weave Effect Planning with Colour Inserts

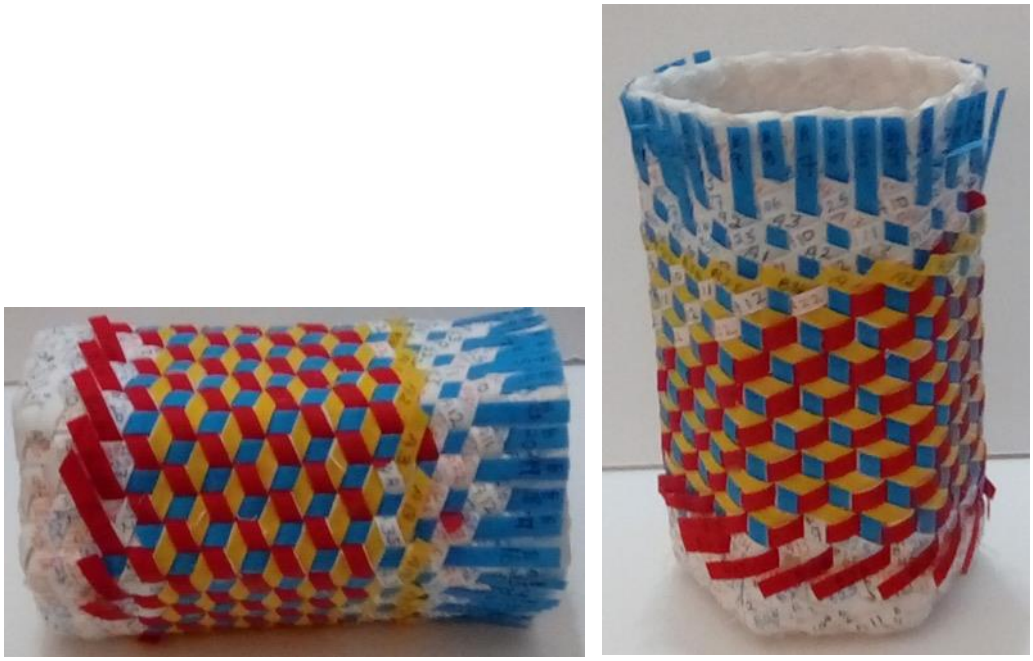


Figure 35. Basket for Colour and Weave Effect Planning with Colour Inserts. Source Susan Brunton.

At the end of each coloured weaving strip, write the position number and letter that corresponds to the position of the strip on the Basket for Colour and Weave Effect Pattern Planning

Step 8

Adjusted Colour Pattern Strip Planner - Tool 5 developed for this research

Starting with the vertical strips on the Basket for Colour and Weave Effect Pattern Planning, remove each weaving strip from the basket side and place it in the appropriate column of the Adjusted Colour Pattern Strip Planner

Adjusted Colour Pattern Strip Planner

Structural Pattern – Tumbling Blocks

Colour Pattern – Tumbling Blocks – 3 colours

Base Shape – 6 sides

Base Strips – Group 1, 12 strips (1 – 12)

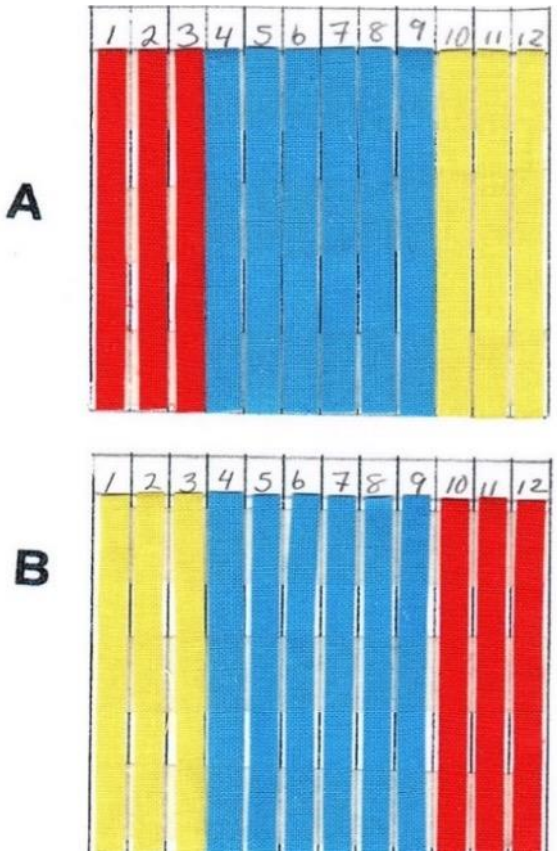


Figure 36. Adjusted Colour Pattern Strip Planner - Group One - Source Susan Brunton.

Adjusted Colour Pattern Strip Planner

Diagonal Strips - top right to bottom left, Group 2

Using diagonal Plaiting strips, top right to bottom left, remove each strip from the basket side and place it in the appropriate column of the Adjusted Colour Pattern Strip Planner.

Adjusted Colour Pattern Strip Planner

Structural Pattern – Tumbling Blocks

Colour Pattern – Tumbling Blocks – 3 colours

Base Shape – 6 sides

Base Strips – Group 2, 12 strips (13 – 24)

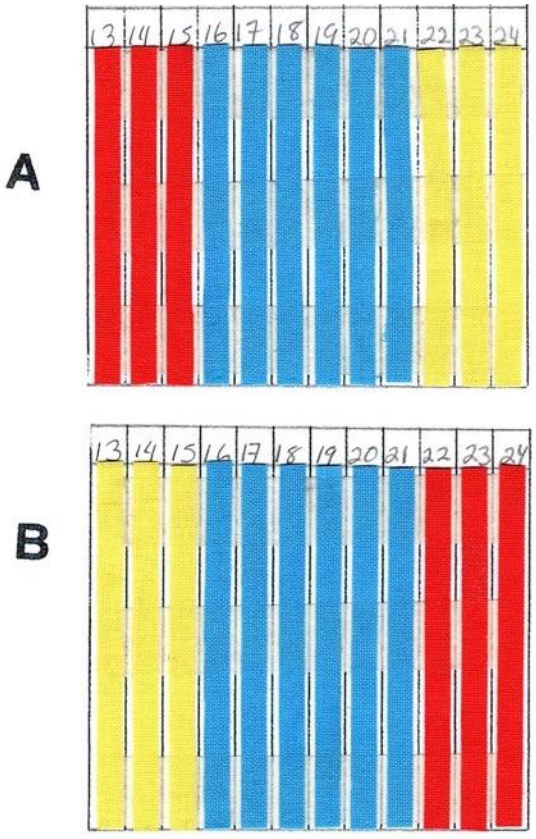


Figure 37. Adjusted Colour Pattern Strip Planner - Group Two - Source Susan Brunton.

Adjusted Colour Pattern Strip Planner

Diagonal Strips - top left to bottom right, Group 3

Using diagonal strips, top left to bottom right, remove each weaving strip from the basket side and place it in the appropriate column of the Adjusted Colour Pattern Strip Planner.

Adjusted Colour Pattern Strip Planner

Structural Pattern – Tumbling Blocks

Colour Pattern - Tumbling Blocks – 3 colours

Base Shape – 6 sides

Base Strips – Group 3, 12 strips (25 – 36)

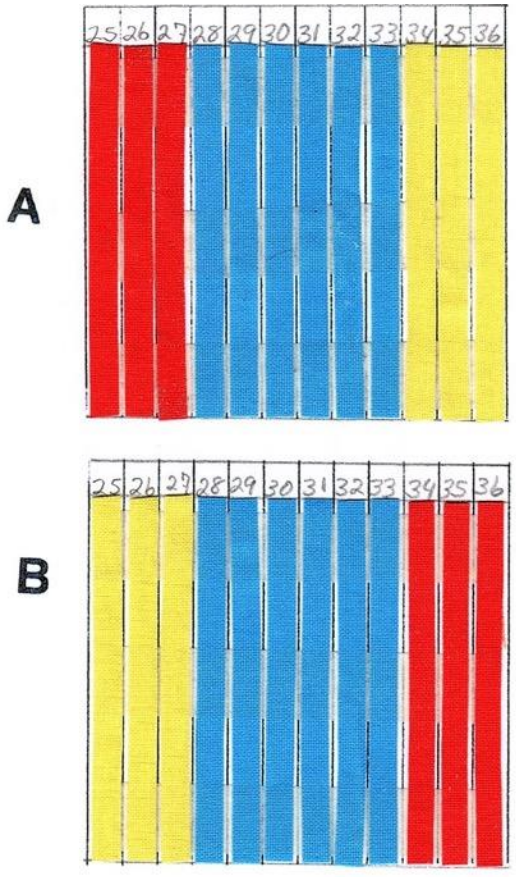


Figure 38. Adjusted Colour Pattern Strip Planner - Group Three - Source Susan Brunton.

Adjusted Individual Colour Strip Planner

Step 9

Adjusted Individual Colour Strip Planner. Tool 6 developed for this research. Join the A and B sections of each strip from all 3 groups, as plotted on Adjusted Colour Pattern Strip Planner.

Colour Adjusted Individual Strip Planner

Structural Pattern – Tumbling Blocks

Colour Pattern – Tumbling Blocks – 3 colours

Base Shape – 6 sides

Group 1, 12 Strips (1 – 12)

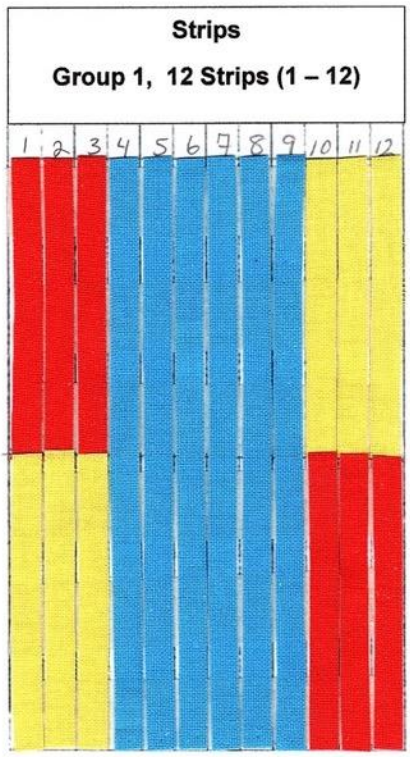


Figure 39. Colour Adjusted Individual Strip Planner - Group One - Source Susan Brunton.

Join the A and B sections of each strip from all 3 groups, as plotted on Adjusted Colour Pattern Strip Planner.

Colour Adjusted Individual Strip Planner

Structural Pattern – Tumbling Blocks

Colour Pattern – Tumbling Blocks – 3 colours

Base Shape – 6 sides

Group 2, 12 Strips (13 – 24)

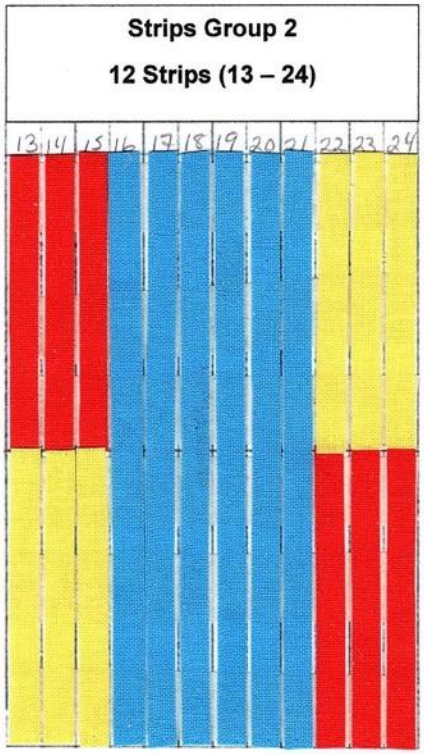


Figure 40. Colour Adjusted Individual Strip Planner - Group Two - Source Susan Brunton.

Join the A and B sections of each strip from all 3 groups, as plotted on Adjusted Colour Pattern Strip Planner.

<u>Colour Adjusted Individual Strip Planner</u>

Structural Pattern – Tumbling Blocks

Colour Pattern – Tumbling Blocks – 3 colours

Base Shape – 6 sides

Group 3, 12 Strips (25 – 36)

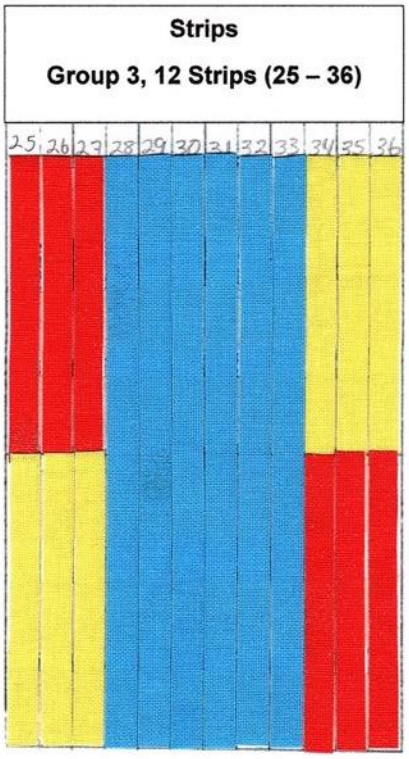


Figure 41. Colour Adjusted Individual Strip Planner - Group Three - Source Susan Brunton.

Step 10

Preparing the Colour Adjusted Plaiting Strips

Technique 9

Using the Adjusted Individual Strip Planner as a guide, prepare the actual plaiting strips.

When a plaiting strip has 2 colours along its length, join the A and B sections together with fabric glue to create one weaving strip.

Using the colour adjusted weaving strips weave the basket base, turn the 6 corners and plait up the basket walls using the Double Wall Construction Technique.

Colour Adjusted Individual Strip Base

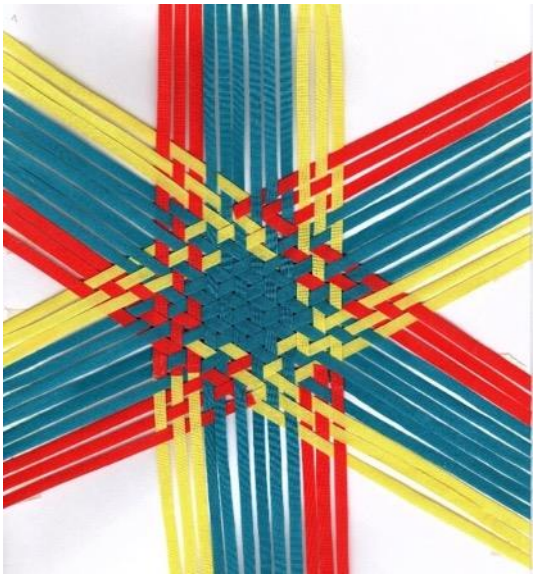


Figure 42. Colour Adjusted Individual Strip Base - Source Susan Brunton.

Triaxial Bias Plaited Colour Adjusted Basket

Tumbling Blocks Pattern

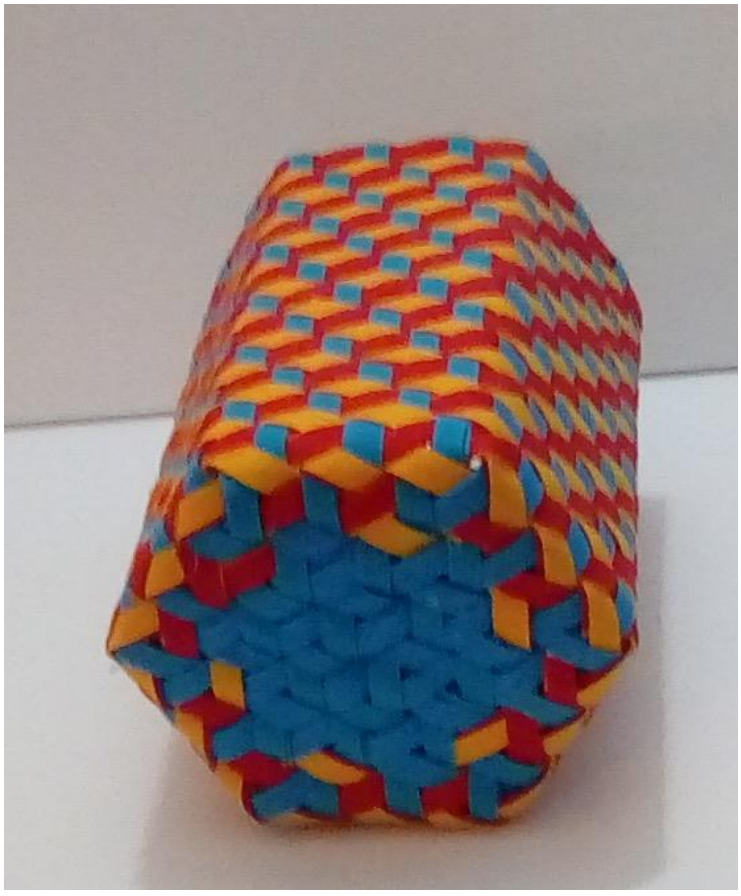


Figure 43. Triaxial Bias Plaited Basket - Colour Adjusted - Source Susan Brunton.

Step 11

Results of the Colour Adjusted Research Process

Triaxial Bias Plaited Baskets - Pattern: Tumbling Blocks

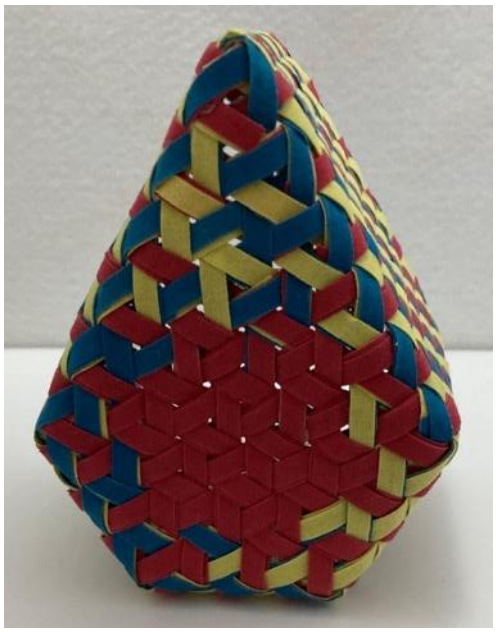
Figure 44. Triaxial Bias Plaited Colour Adjusted Pattern Basket - Tumbling Blocks Pattern - Source Susan Brunton.

Results of the Colour Adjusted Research Process – Step 11 for all Patterns

Pattern: Tumbling Blocks – Five Sides - Adjustment Needed

Basket Bottom – Original Colour

Basket Wall – Original Colour



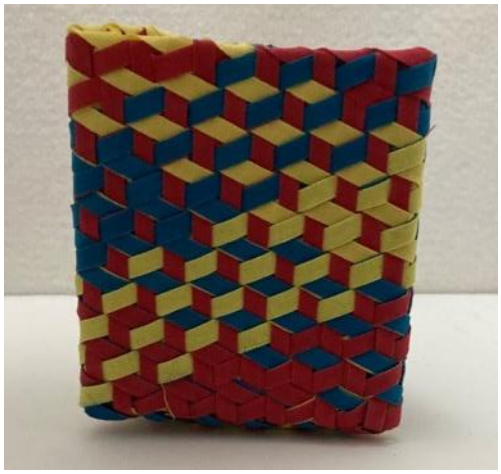
Basket Bottom – Colour Adjusted

Basket Wall – Colour Adjusted

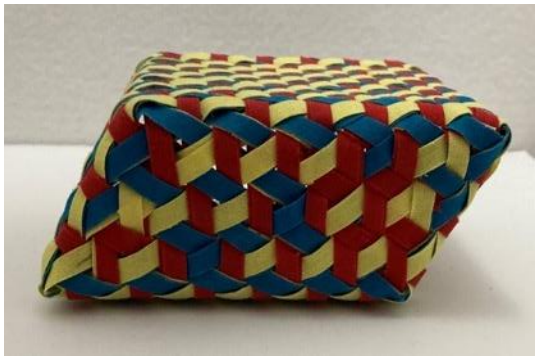
Figure 45. Tumbling Block Pattern - Five sided colour adjusted basket - Source Susan Brunton.

Pattern: Tumbling Blocks – Four Sides - Adjustment Needed

Basket Bottom – Original Colour



Basket Wall – Original Colour



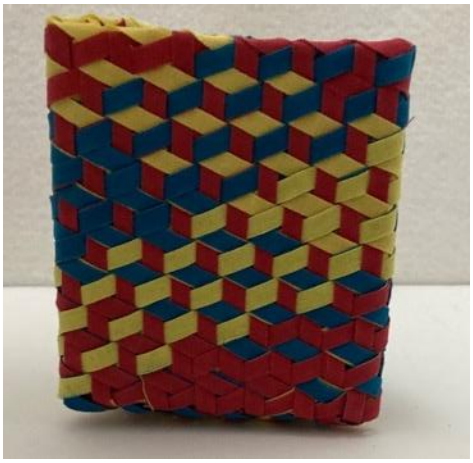
Basket Bottom – Colour Adjusted

Basket Wall – Colour Adjusted

Figure 46 Tumbling Blocks - Four Sided, - Colour adjusted basket - Source Susan Brunton.

Pattern: Tumbling Blocks – Three Sides - Adjustment Needed

Basket Bottom – Original Colour



Basket Wall – Original Colour

Basket Bottom – Colour Adjusted

Basket Wall – Colour Adjusted

Figure 47. Tumbling Blocks - Three Sided - Colour adjusted basket - Source Susan Brunton.

Framed Star Pattern

Experimental Results - No Adjustments Required

Framed Star Six Sides

Basket Bottom

Basket Wall

Framed Star Five Sides

Basket Bottom

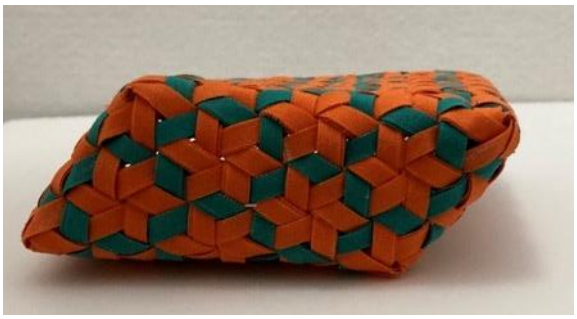
Basket Wall

Figure 48. Six and Five Sided, Framed Star, No Adjustment Needed Baskets - Source Susan Brunton.

Framed Star Pattern

Experimental Results - No Adjustments Required

Framed Star 4 Sides



Basket Bottom

Basket Wall

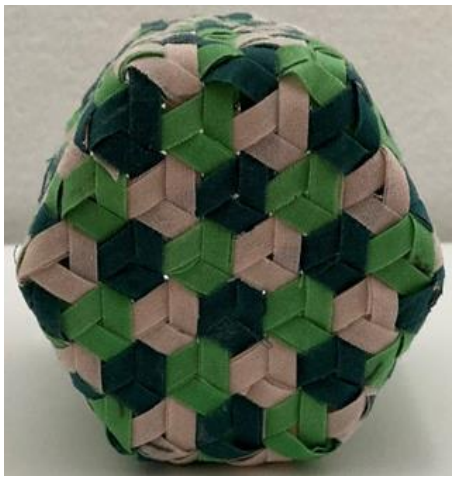
Framed Star Three Sides

Basket Bottom

Basket Wall

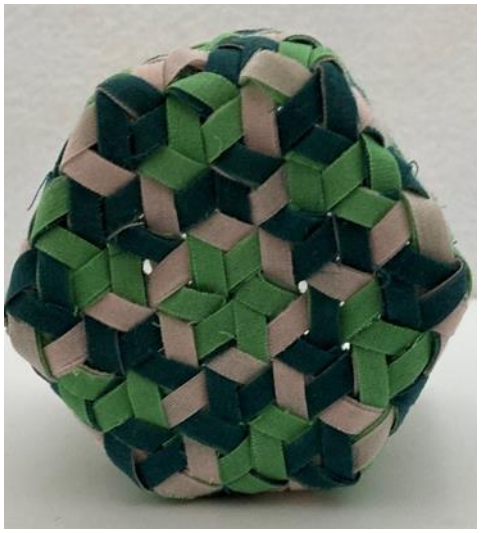
Figure 49. Four and Three Sides, Framed Star, No Colour Adjustment Needed Baskets - Source Susan Brunton.

Pattern: Three Colour Cubes – Six Sides - Adjustment Needed



Basket Bottom – Original Colour

Basket Wall – Original Colour

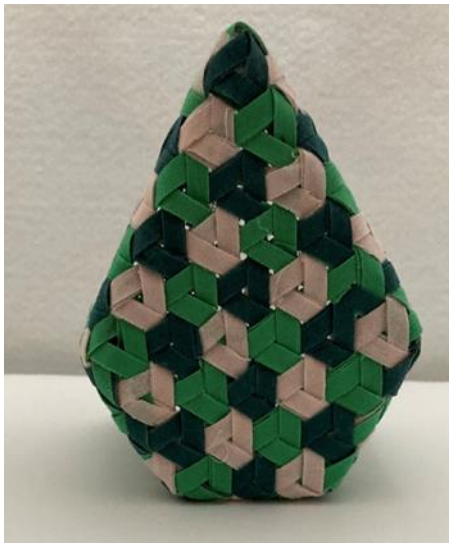


Basket Bottom – Colour Adjusted

Basket Wall – Colour Adjusted

Figure 50. Three Colour Cubes Pattern - Six Sides - Adjustment Needed – Baskets - Source Susan Brunton.

Pattern: Three Colour Cubes – Five Sides - Adjustment Needed



Basket Bottom – Original Colour

Basket Wall – Original Colour

Basket Bottom – Colour Adjusted

Basket Wall – Colour Adjusted

Figure 51. Three Colour Cube Pattern - Five Sides - Adjustment Needed Baskets - Source Susan Brunton.

Pattern: Three Colour Cubes – Four Sides - Adjustment Needed

Basket Bottom – Original Colour

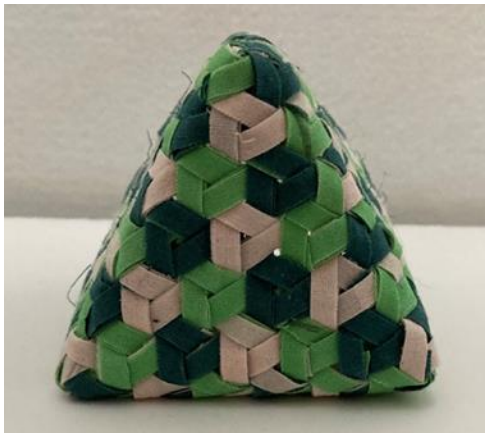
Basket Wall – Original Colour

Basket Bottom – Colour Adjusted

Basket Wall – Colour Adjusted

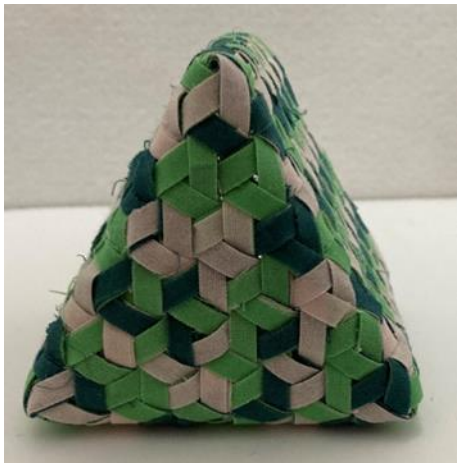
Figure 52. Three Colour Cubes Pattern - Four Sides - Adjustment Needed Baskets - Source Susan Brunton.

Pattern: Three Colour Cubes – Three Sides - Adjustment Needed

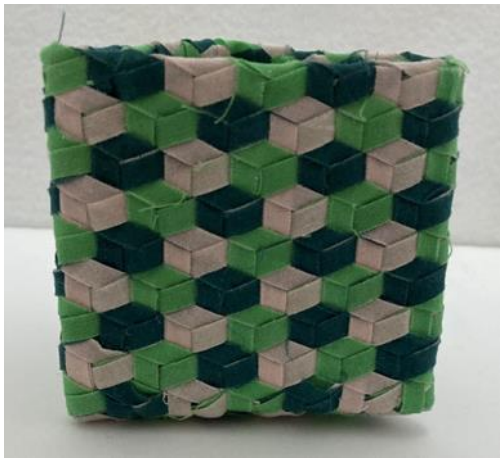


Basket Bottom – Original Colour

Basket Wall – Original Colour



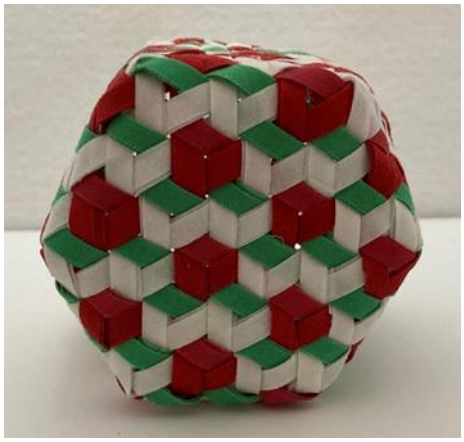
Basket Bottom – Colour Adjusted



Basket Wall – Colour Adjusted

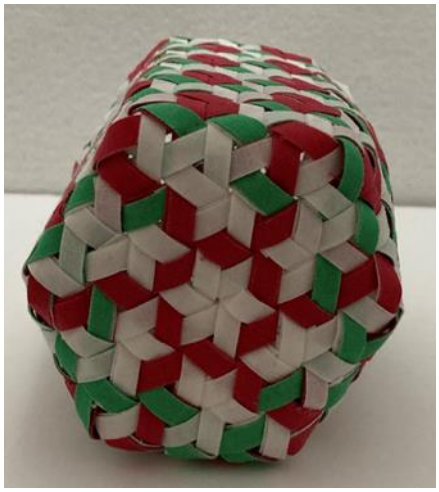
Figure 53. Three Colour Cubes Pattern - Three Sides - Adjustment Needed – Baskets - Source Susan Brunton.

Pattern: Cube Rose – Six Sides - Adjustment Needed



Basket Bottom - Original Colour

Basket Wall – Original Colour



Basket Bottom – Colour Adjusted

Basket Wall – Colour Adjusted

Figure 54. Cube Rose Pattern - Six Sides - Adjustment Needed Baskets - Source Susan Brunton.

Pattern: Cube Rose – Five Sides - Adjustment Needed

Basket Bottom - Original Colour

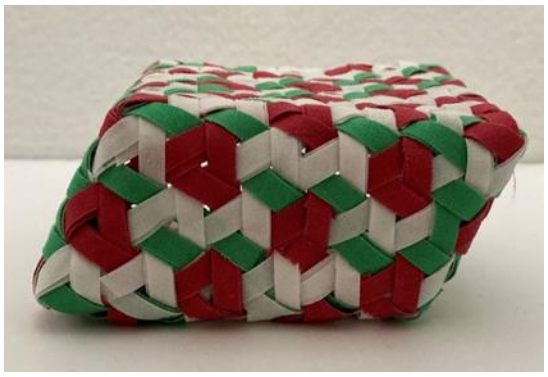
Basket Wall – Original Colour

Basket Bottom – Colour Adjusted

Basket Wall – Colour Adjusted

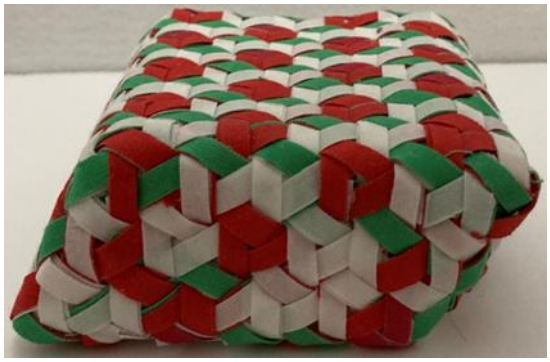
Figure 55. Cube Rose Pattern - Five Sides - Adjustment Needed Baskets - Source Susan Brunton.

Pattern: Cube Rose – Four Sides - Adjustment Needed

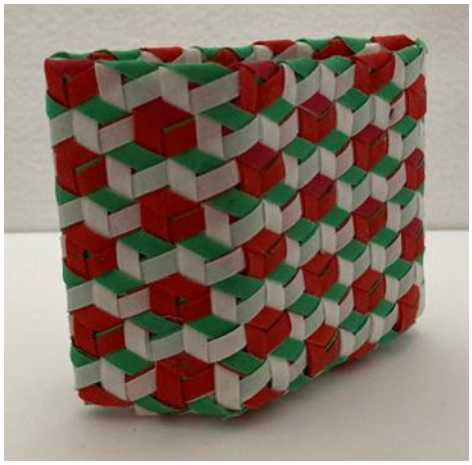


Basket Bottom – Original Colour

Basket Wall – Original Colour



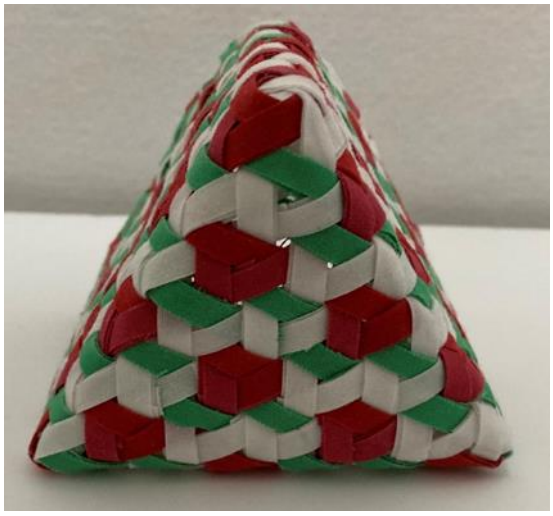
Basket Bottom – Colour Adjusted



Basket Wall – Colour Adjusted

Figure 56. Cube Rose Pattern - Four Sides - Adjustment Needed Baskets - Source Susan Brunton.

Pattern: Cube Rose – Three Sides - Adjustment Needed



Basket Bottom – Original Colour

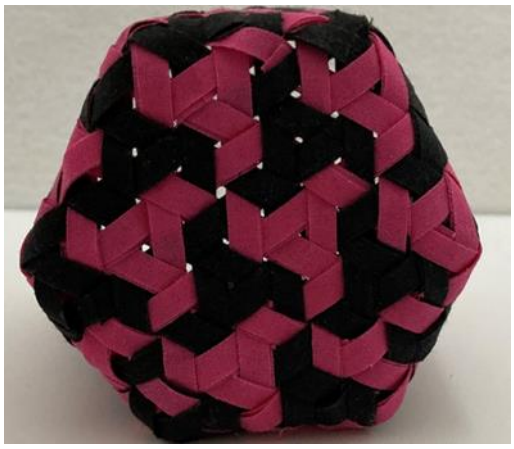
Basket Wall – Original Colour

Basket Bottom – Colour Adjusted

Basket Wall – Colour Adjusted

Figure 57. Cube Rose Pattern - Three Sides - Adjustment Needed Baskets - Source Susan Brunton.

Pattern: Pinwheel – Six Sides - Adjustment Needed



Basket Bottom – Original Colour

Basket Wall – Original Colour

Basket Bottom – Colour Adjusted

Basket Wall – Colour Adjusted

Figure 58. Pinwheel Pattern - Six Sides - Adjustment Needed Baskets - Source Susan Brunton.

Pattern: Pinwheel – Five Sides - Adjustment Needed

Basket Bottom – Original Colour

Basket Wall – Original Colour

Basket Bottom – Colour Adjusted

Basket Base – Colour Adjusted

Figure 59. Pinwheel Pattern - Five Sides - Adjustment Needed Baskets - Source Susan Brunton.

Pattern: Pinwheel – Four Sides - Adjustment Needed

Basket Bottom – Original Colour

Basket Wall – Original Colour

Basket Bottom – Colour Adjusted

Basket Wall – Colour Adjusted

Figure 60. Pinwheel Pattern - Four Sides - Adjustment Needed Baskets - Source Susan Brunton.

Pattern: Pinwheel – Three Sides - Adjustment Needed

Basket Bottom – Original Colours

Basket Wall – Original Colours

Basket Bottom – Colour Adjusted

Basket Wall – Colour Adjusted

Figure 61. Pinwheel Pattern - Three Sides - Adjustment Needed Baskets - Source Susan Brunton.

Pattern: Row of Purple Flowers – Six Sides - Adjustment Needed

Basket Bottom – Original Colours

Basket Wall – Original Colours

Basket Bottom – Colour Adjusted

Basket Wall – Colour Adjusted

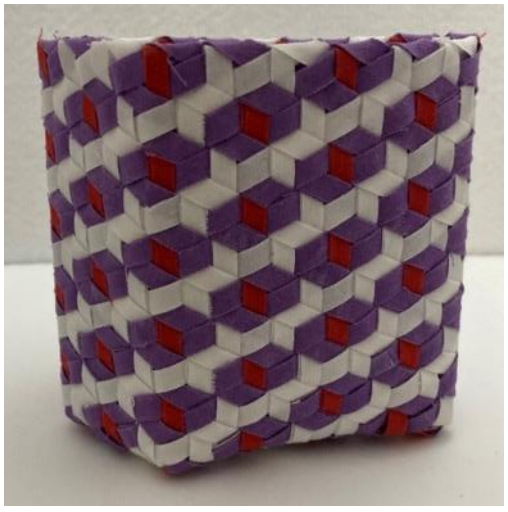
Figure 62. Row of Purple Flowers - Six Sides - Adjustment Needed Baskets - Source Susan Brunton.

Pattern: Row of Purple Flowers – Five Sides - Adjustment Needed

Basket Bottom – Original Colour

Basket Wall – Original Colour

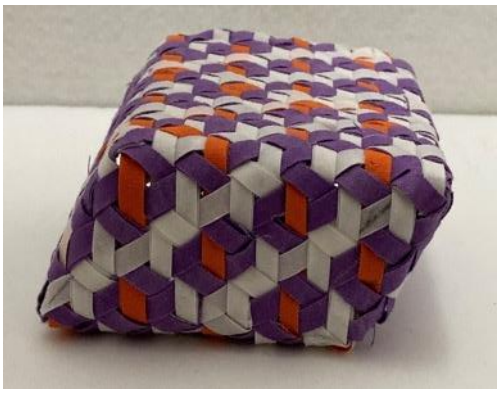
Basket Bottom – Colour Adjusted



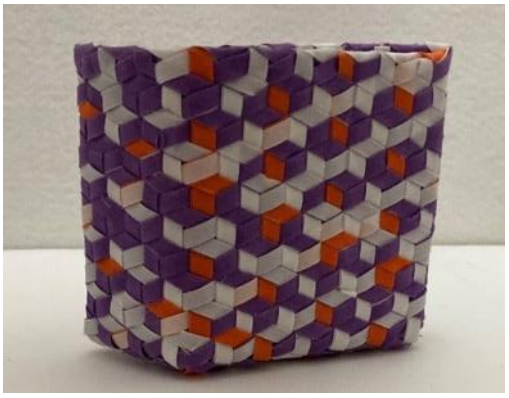
Basket Wall – Colour Adjusted

Figure 63. Row of Purple Flowers Pattern - Five Sides - Adjustment Needed Baskets - Source Susan Brunton.

Pattern: Row of Purple Flowers – Four Sides - Adjustment Needed



Basket Bottom – Original Colour



Basket Wall – Original Colour

Basket Bottom – Colour Adjusted

Basket Wall – Colour Adjusted

Figure 64. Row of Purple Flowers - Four Sides - Adjustment Needed Baskets - Source Susan Brunton.

Pattern: Row of Purple Flowers – Three Sides - Adjustment Needed

Basket Bottom – Original Colour

Basket Wall – Original Colour

Basket Bottom – Colour Adjusted

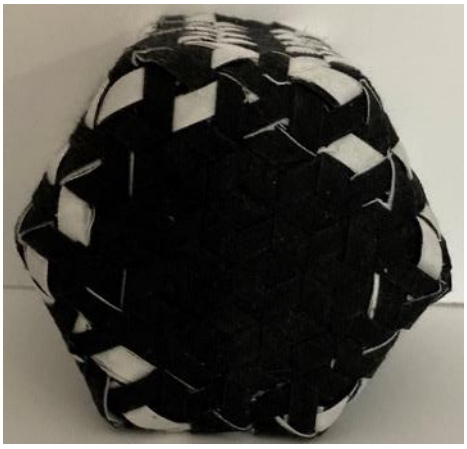
Basket Wall – Colour Adjusted

Figure 65. Row of Purple Flowers - Three Sides - Adjustment Needed Baskets - Source Susan Brunton.

Pattern: ZZZ – Six Sides - Adjustment Needed

Basket Bottom – Original Colour

Basket Wall – Original Colour



Basket Bottom – Adjusted Colour Colour

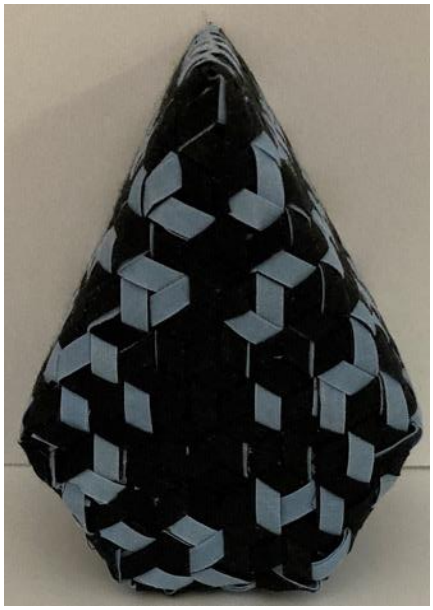
Basket Wall – Adjusted

Figure 66. ZZZ Pattern - Six Sides - Adjustment Needed Baskets - Source Susan Brunton.

Pattern: ZZZ – Five Sides - Adjustment Needed

Basket Bottom – Original Colour

Basket Wall – Original Colour



Basket Bottom – Colour Adjusted

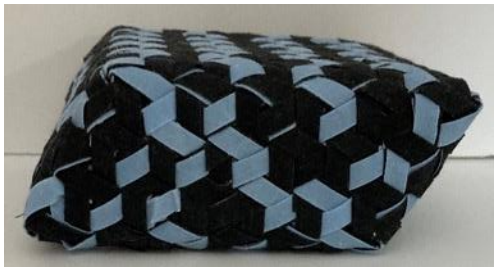
Basket Wall – Colour Adjusted

Figure 67. ZZZ Pattern - Five Sides - Adjustment Needed Baskets - Source Susan Brunton.

Pattern: ZZZ – Four Sides - Adjustment Needed

Basket Bottom – Original Colour

Basket Wall – Original Colour



Basket Bottom – Colour Adjusted

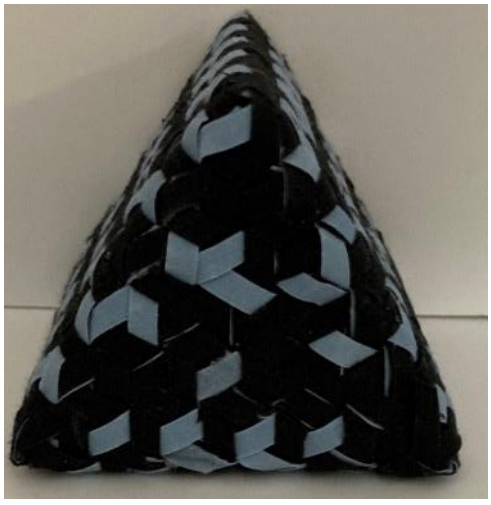
Basket Wall – Colour Adjusted

Figure 68. ZZZ Pattern - Four Sides - Adjustment Needed Baskets - Source Susan Brunton.

Pattern: ZZZ – Three Sides - Adjustment Needed

Basket Bottom – Original Colour

Basket Wall – Original Colour



Basket Bottom – Colour Adjusted

Basket Wall – Colour Adjusted

Figure 69. ZZZ Pattern - Three Sides - Adjustment Needed Baskets - Source Susan Brunton.

Chapter Five

Summary and Conclusion

The research question that framed this experimental thesis is: how can triaxial bias plaited basketry be preserved, and what approaches can be taken to help understand the complexity of its construction and pattern for future weavers?

For this research study, three objectives were created. First, to create a working body of knowledge embodying existing triaxial bias plaited basketry theory, technique and practice. Second, to develop new colour and weave design techniques to advance the knowledge and provide new design elements for present day and future triaxial weavers. Finally, to create a document to preserve and disseminate triaxial bias plaited basketry knowledge, theory and technique for present and future makers. Fulfilling the operational objectives demonstrates how the thesis contributes to developing new theory and technique while advancing and preserving this ancient triaxial plaiting technique.

Triaxial Bias Plaited Basketry – Body of Knowledge

The Literature Review (chapter 2) assembles, summarizes, and organizes triaxial bias plaiting written materials over years of my learning and studio practice. Organized into functional categories, the literature review was

designed to facilitate locating and bringing together materials about handwoven triaxial weaving and basket making. A collection of books, journal articles, magazines, newspaper articles, notes, pamphlets and scholarly theses listed in the bibliography is presented to facilitate current and future weavers' access to the triaxial bias plaiting resources available at the time of writing this thesis. The literature review and bibliography together form the beginning of the body of knowledge for handwoven triaxial bias plaiting. Hopefully in time more new makers will add to the sparse material available now.

Colour and Weave Control in Triaxial Bias Plaiting Basketry

The experimental results presented in this thesis prove conclusively, that it is possible to control the colour and weave effect present in triaxial bias plaited basketry. Fifty-two experimental baskets were woven in this research study with seven colour patterns over four basket shapes. All the experimental basket experiments were successful in recognition and colour placement for triaxial bias plaited basketry. Basket makers can use the experimental research procedure designed for this research to make the colour adjustments necessary to place the colour pattern where weavers' desire the colour to go.

This research proves that mathematician Paul Gailiunas's opinion regarding colour patterning in triaxial bias plaiting expressed in the three

articles referenced in the literature review is not correct (Gailiunas, 2011, 2013, 2017). Gailiunas failed to understand that even though handwoven bias plaiting theory dictates that triaxial bias plaiting elements present a colour face on the basket walls and a different colour pattern on the basket base, the weaving element can be constructed of different coloured materials then joined together to function as a single weaving element thus satisfying the structural and colour placement needs to control the colour design in the basket. The methodology and research results chapters clearly show this anomaly and through the original research done in this thesis, the research format is used to analyze and determine the necessary colour placement adjustments required to fulfill the colour design needs. Through understanding the underlying structure of bias plaiting – namely the connection through the basket base between the two walls' weaving elements – causes the anomaly at the corner turnup and as seen in the experimental research, colour adjustments are possible to control the colour and weave effect.

To Preserve and Disseminate Triaxial Bias Plaited Basketry Knowledge, Theory and Practice.

This thesis is the document that can serve to preserve and carry forth the historical and present day triaxial bias plaiting knowledge, theory and studio practice as it stands on the date of writing. This work is a beginning in documenting, preserving and encouraging new interest in triaxial bias

plaiting through the new colour and weave technique design and pattern developments made in this research. More research and development of handwoven triaxial bias plaiting needs to be done to preserve this ancient weaving technology; however the achievement of colour control in triaxial plaiting is an important step.

New Knowledge Developed in this Research

The research results clearly show that colour patterns and colour and weave control are possible in triaxial bias plaited basketry. Through utilizing the systemic examination of colour pattern and structural pattern weavers will now be able to incorporate colour and weave techniques in their work.

The colour and weave colour pattern adaptation developed in this research is new knowledge in triaxial bias plaiting. The eleven-step research process can be used by basket makers in their practice to develop their own colour patterns. The control of colour and weave technique is a critical skill for weavers and by utilizing this research makers can add colour design to their work.

Previous limitations on the use of colour patterns in triaxial bias plaiting are no longer a barrier to colour placement and design. Present and future weavers will now possess the colour and weave techniques to expand the

use of colour in their work. Hopefully, new weavers will try triaxial bias plaiting now that colour techniques are available.

Addition to the Theoretical Body of Knowledge

The systematic deconstruction of triaxial bias plaited basketry in the Making With Rigour methodology of this thesis is a beginning in laying down triaxial handwoven theory. A strong theoretical background will help weavers understand the weave structure and guide weavers in the techniques necessary to champion this type of weaving.

Limitations

Much more work, in practice, theory and research, needs to be done to preserve and develop handwoven triaxial weaving and basketry. This research focuses only on the Tumbling Blocks structural pattern of triaxial bias plaiting. There are many more patterns to explore and perhaps new structural patterns to develop.

This thesis focused on triaxial bias plaited basketry and there is work needed in non-bias basketry and flat triaxial plaiting, both bias and non-bias. Even though triaxial hand weaving is an ancient technique it has remained obscure and has not attracted many makers. If future weavers do not take on the challenge of handwoven triaxial textiles it may become extinct however if others learn and practice this technique it may be saved,

Closing Remarks

This thesis represents a beginning step in the in-depth study and research of handwoven triaxial bias plaited basketry. Triaxial hand weaving is difficult and challenging to learn; however, the rewards are plentiful. Having colour and weave control techniques as developed in this research for triaxial bias plaited basketry is very exciting for the future of this weave structure. Even though this type of basketry is ancient, this research proves new discoveries are possible!

Many years of weaving provided important practice-based research for this thesis. Despite the number of pages of the bibliography there is little information about how to weave triaxial bias plaited basketry. Years of trial and error trying to develop colour techniques contributed to this thesis.

My discovery of the MathWeave group and their research methodology, Making with Rigour, led to the linking of mathematics and triaxial weaving in my studio practice. Examining how non-weavers approach complex weaving challenges put my studio practice on a new interdisciplinary path. Utilizing the critical thinking process in step with a logical problem-solving approach was the key methodology used to deconstruct the weaving process to uncover the pivotal theory to gain control over the anomaly responsible for colour pattern disbursement in triaxial bias plaited basketry.

My primary goal in coming to OCAD University was to leave a document in the form of my thesis, to help preserve triaxial bias plaited basketry. It was important to me to do what I could to help preserve this endangered handwoven technique. To me it is unconscionable that ancient weaving technology is allowed to disappear taking with it the knowledge and skill needed to preserve the gifts of our early ancestors. Any present or future weavers can use my thesis to help them with their own weaving journey to learn and grow triaxial bias plaited basketry. I hope other weavers will preserve and share their skills in the future.

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