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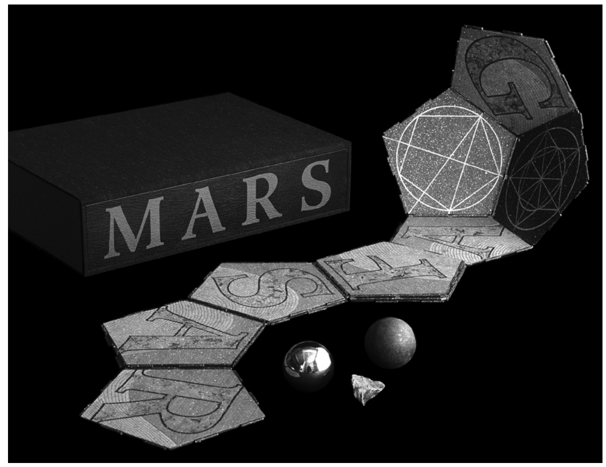
Artists' Books as Articulated Sculpture

Daniel Kelm's Wire Edge Binding Structures

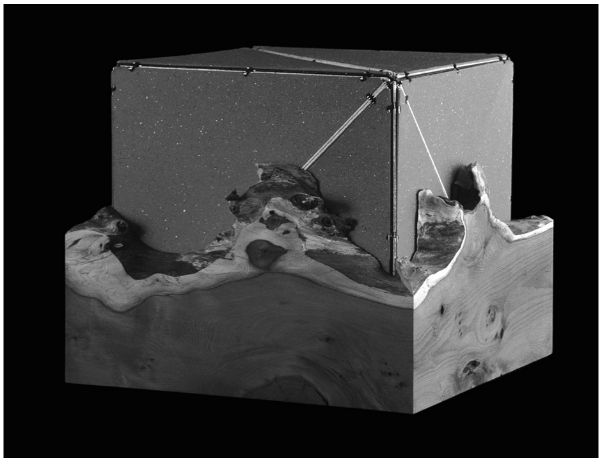
A NOTE ON THIS ARTICLE: *In 1999 I was invited to deliver a presentation for the Guild of Book Workers Standards of Excellence Seminar in Chicago concerning my development of what had been known for some time as "wire edge binding." This provided an opportunity to organize and crystallize thoughts that had been percolating since 1984 when I first experimented with wire edge. The four years between the Guild seminar and the publication of this article in the GBW Journal (Fall, 2003) saw continuous development of the structures but the basic description remains the same. This article was based on my recollection of the GBW presentation, assisted by a reading of Jim Dorsey's article describing that event for the Binder's Guild Newsletter (Volume XXIII, No. 1), and is now updated and illustrated for the Society of Bookbinders Conference 2011.*

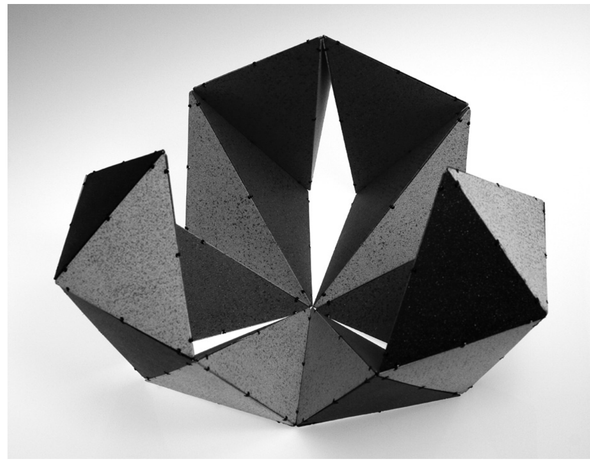
Anyone who spends time with me knows that I fell in love with chemistry at the age of seven. My course was set for the next two decades by an experience which combined my potentially fatal production of chlorine gas, with the eye-opening revelation of being able to write the chemical equation for the reaction. It was fantastic. The potency that I felt through the correspondence of physical experience and intellectual explanation captured my imagination, and kept me in academic studies for twenty years. In 1978, having realized that the intellectual side of my studies had overwhelmed the physical, I made the transition to the study and practice of book arts. Here I found a pursuit that once again fired my imagination, and gave me the opportunity to combine creatively the physical elements of material and structure with the intelligence of text and imagery. The next five years were spent in various binderies learning the craft of traditional cloth and leather book binding, as well as gold leaf work in edge gilding, gold tooling, and stamping. After opening my own studio full time in 1983, I continued to explore the more traditional techniques of interpretive fine binding (what many call Design Binding) while progressively incorporating more extreme sculptural elements. Initially, the low relief sculpture was fully contained on the cover of a fine binding of a letterpress printed codex text block. Gradually, the cover and text block were integrated until no distinction remained. At this point my work left the realm of interpretive fine binding, and entered that of artists' books.



The most compelling force behind this transition was a desire to find binding structures that did more than passively carry text and imagery. I wanted them actively to support the story through material, structure, and movement. Once again the need for a balance between physicality and intellectualization came to the fore. Commercial books with normal trade bindings seemed to me to exalt the written text while denigrating the physical body of the book. For me, this view has been most notably represented by paperbacks of classic texts — bound poorly and with materials that yellow and fall to pieces much too quickly.

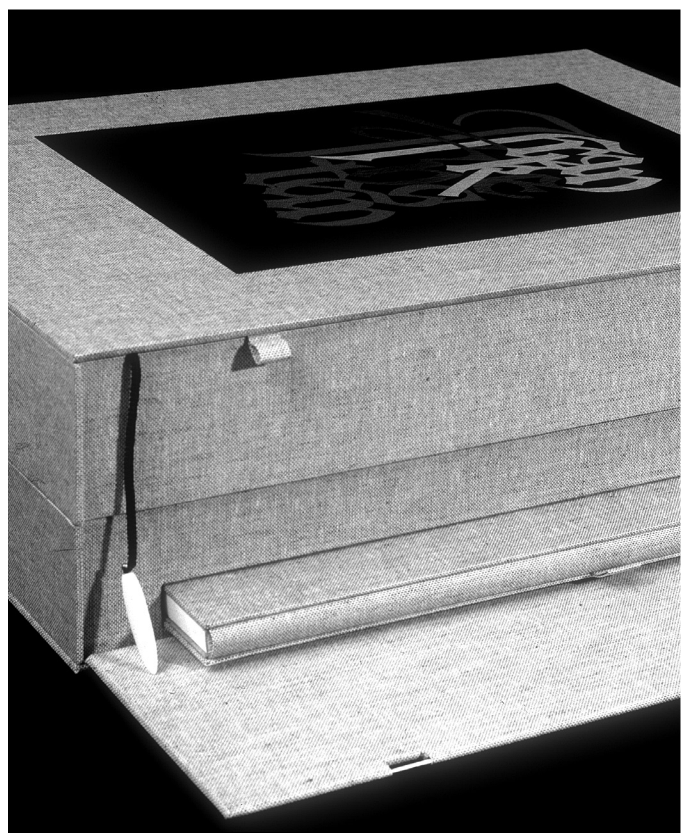
To tell a story through the materials and structure of a book, as well as through its text and imagery, requires a break from tradition. As physical movement becomes more important, the binding structure needs to allow for a greater variety of articulated joints. My research to figure this out began in 1984, and has resulted in the style known as wire edge binding. The name derives from the fact that each simple binding unit (section or single leaf/panel) has



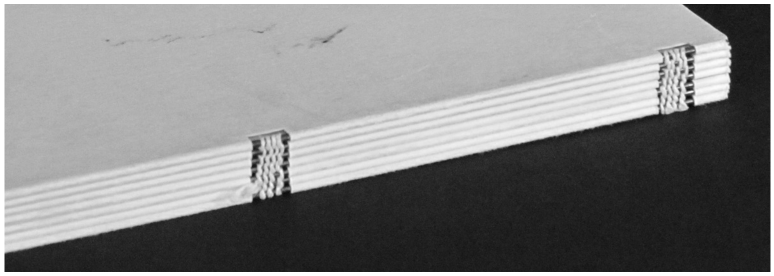


wire attached to all edges that are to be joined to another single unit. The connection between adjacent units is made at the area of exposed wire, using thread or metal to bridge the space. Codex and accordion configurations are beautifully articulated in this fashion, as are complex folding and movable sculpture.

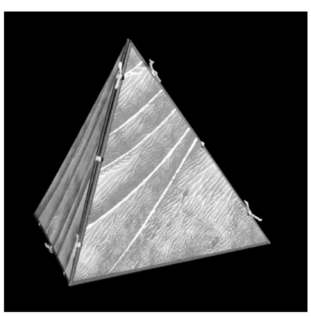
I found inspiration from boxmaking, not binding, for placing wire at the extreme edge of a panel. My 1984 project of producing a five copy interpretive fine binding, limited edition for the Pennyroyal Press Frankenstein required the engineering of a box elaborate enough to serve many functions. It needed to contain the leather-bound book, protect its leather covered cast paper cover, and provide a slipcase enclosure for the extra suite of prints. In order to reduce the sidewall height, and to present the binding more openly, I designed the box with low walls meeting at the center, suitcase-fashion, rather than overlapping as they do in a clamshell box. In contrast with the latter, this style requires a clasp to secure the closure of the two trays. For Frankenstein I resolved the issue by constructing a flap hinged to one tray and extending across to the second trays' outside edge. Here, two fabric loops were positioned to pass through rectangular openings on the flap edge when it was closed. The necessity for the rectangular opening to be located as close to the edge as possible, provided the impulse for embedding a metal rod in the cloth

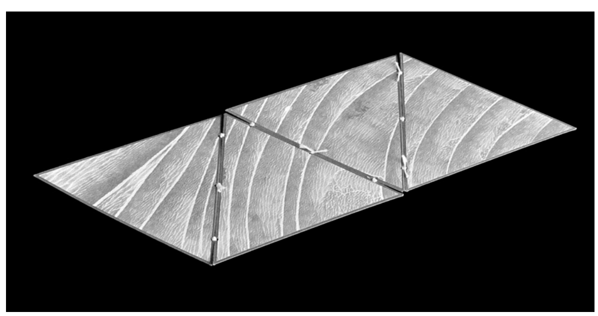


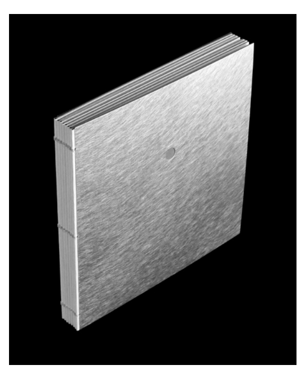
wrapped panel. On examination, the rod defining the outer edge of the opening appeared to offer an ideal anchor for attaching one panel to another. A quick-and-dirty model was produced in which a number of threads were individually and successively tied in square knots around the exposed wire in each panel. The result was a book of rigid pages that opened flexibly and smoothly, creating perfectly flat spreads.



The use of a straight wire or rod in this hinging arrangement defines the center of rotation so clearly that these models provide a good demonstration for the general requirements of flexible hinging. A structure in which two units are connected through a single, common axis (a piano hinge, for example) will normally achieve approximately 180 degrees of rotation before the material of the two units run into each other. Complete rotation is thus possible if two pivot axes are linked closely, the sum of the two 180 degree ranges equaling 360 degrees. Limiting connections to pairs of edges results in an accordion structure, whereas stacking the wire edges and binding them all together produce a codex configuration.

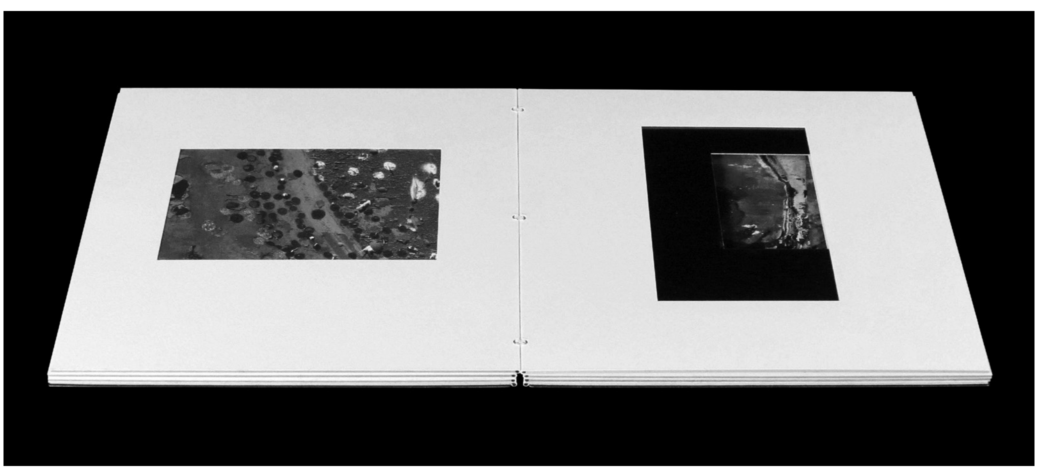




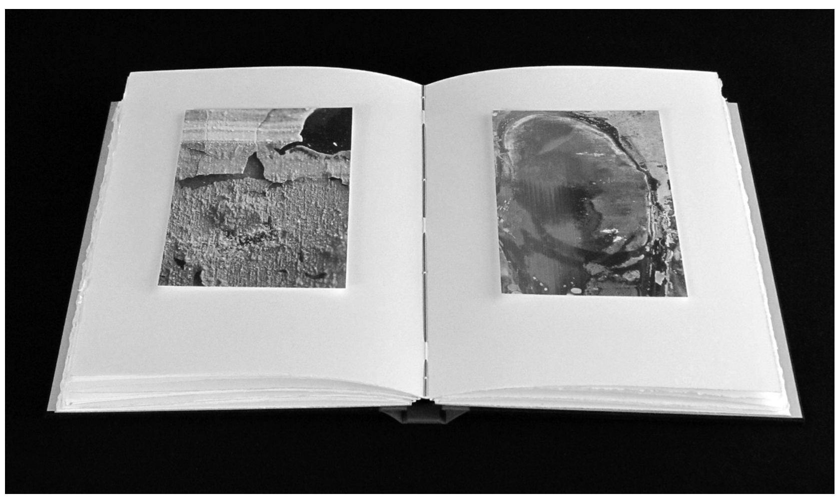


The somewhat mechanical nature of this style of binding lends itself easily to a schematic analysis. However, the same set of points will apply to the movement of traditional, thread-sewn bindings. The pivot in these bindings is defined by the point where thread emerges through the folded edge of the section. Given that each section pivots independently along its own back fold, two sewn sections will demonstrate 360 degrees of movement relative to each other. As thickness builds up when three or more sections are sewn together, rotation is reduced to less than 360 degrees. The opening between sections produces a flat spread, while within sections the stiffness of the paper (or conversely, its drape) determines the openness of the spread.

In most of the codex binding structures I now use, I have eliminated or at least minimized the spine lining in order to maximize the flexibility of the book. A binding with sections sewn all along on tapes or cords will exhibit great flexibility, which progressively decreases as pasted or glued linings are successively added to the spine. While flexible enough to allow the spine to arch and throw out, a single layer of paper lining will give great stability to the spine by constraining movement from head to tail and side to side. Pasting it to the spine folds of the text block very effectively fixes the relationship of all sections. This stability is especially important at the kettle stitches. Except at the kettle stitch, thread emerging from the spine folds is supported in both directions, so does not put undo stress on the paper. At the kettle stitch it is supported in one direction only. Here, movement head to tail can result in enlargement of the kettle stitch sewing hole. Consequently, bindings with this style of sewing utilize adhered spine linings to restrict selectively the movement between sections. Unfortunately, these linings can also restrict the degree of rotation between two sections. The range of spine linings used runs the whole gamut from a single layer of Japanese tissue used in Gary Frost's sewn boards binding, to the dozen or more layers that are built into a German tube binding.

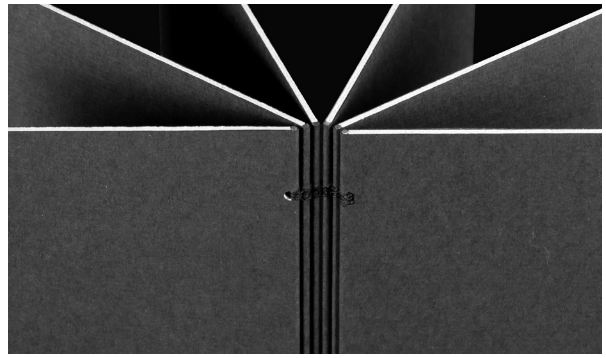


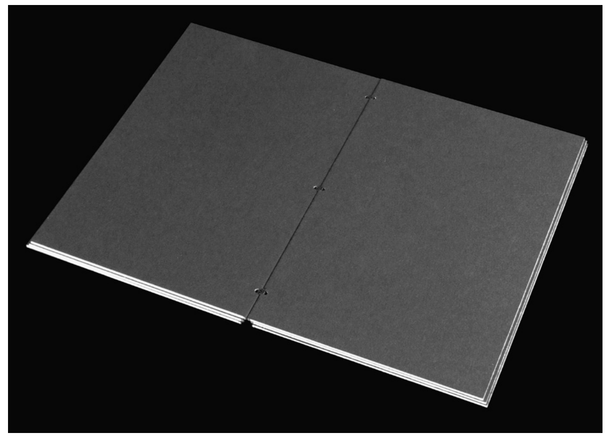
Here I confronted a dilemma. I wanted to minimize the linings to maximize flexibility, but I needed the linings to stabilize the kettle stitch. So I asked: can the kettle stitch be eliminated? If we consider only those structures that are sewn all along, the kettle stitches are the only points at which the thread passes from one section to the next. In pondering this, I realized that if the thread did not run all along the inside fold of the section but was instead localized, then the need for the kettle stitch disappears. Paired-needle sewing accomplishes this to a certain degree by decreasing the distance that each thread travels along the spine. Even so, this structure is best used on small, lightweight books, and with some spine lining. Wire edge offers a solution that eliminates completely the head to tail component of the sewing by anchoring thread to wire that itself travels the entire length of the spine. My gutter wire bindings combine the strength and support of raised cords with the flexibility of non-adhesive spines. The thread is localized at each cord because it merely enters the section through the spine fold, wraps around the wire laid into the interior gutter fold, and immediately exits the section through the same hole, ready to wrap the cord in traveling to the next section. Regardless of the details, all wire edge structures share this basic strategy.



The construction of a wire edge binding entails the joining—via thread or metal hinges—of simple wire edge units. As stated already, each simple unit has wire along at least one edge. The wire can be held by several point attachments to the edge, but structurally lies outside of the core structure. This is called an exterior wire. If the core structure is wrapped, the wire can be built into the core edge and secured by the wrapping material. This is called an interior wire.

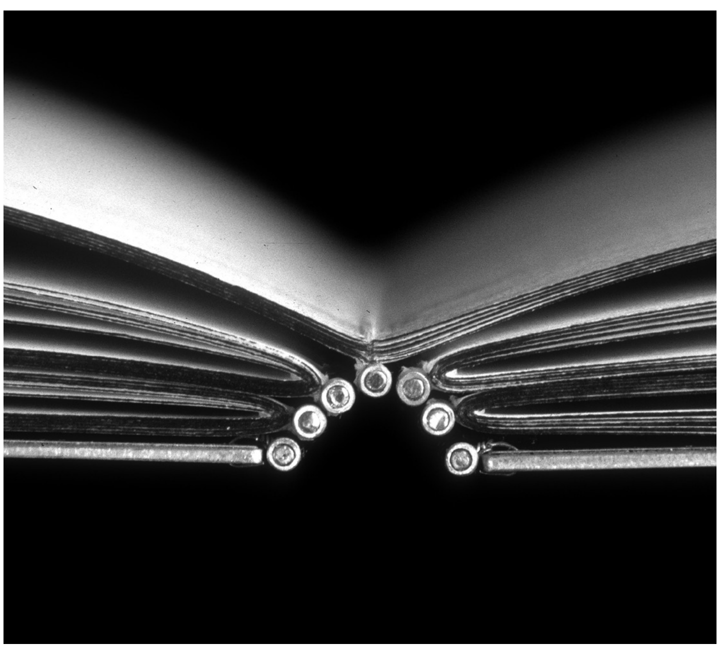
To date, all of the wire edge structures that I have developed fall within the following outline:

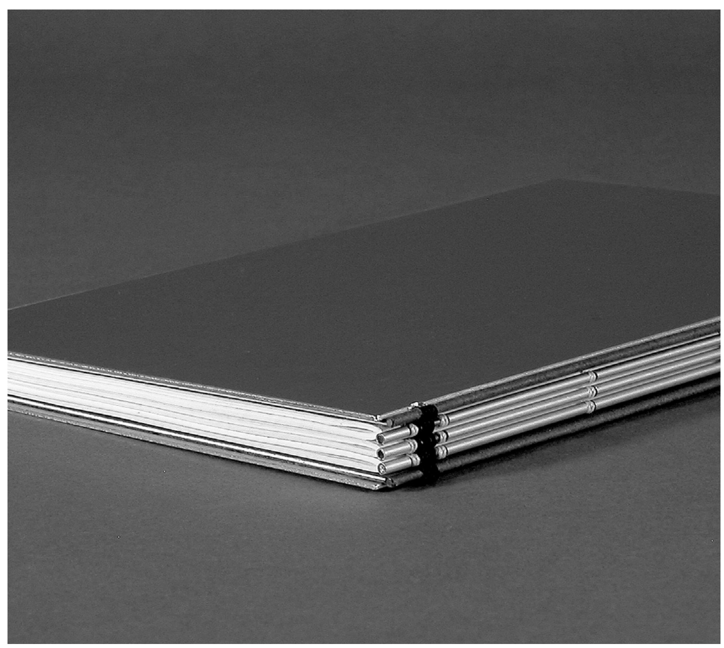




A. Interior wire
- 1. Codex
  - a. Thread
  - b. Metal Hinge
- 2. Accordion
  - a. Thread
  - b. Metal Hinge

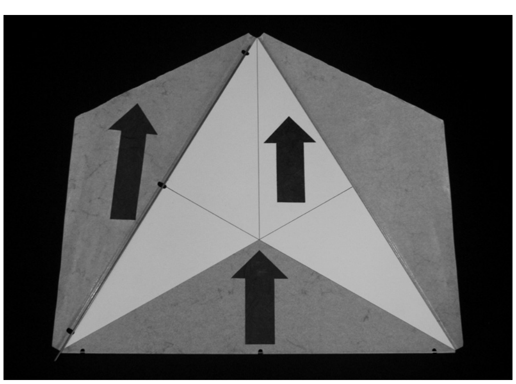
B. Exterior Wire
- 1. Codex
  - a. Thread
  - b. Metal Hinge
- 2. Accordion
  - a. Thread
  - b. Metal Hinge

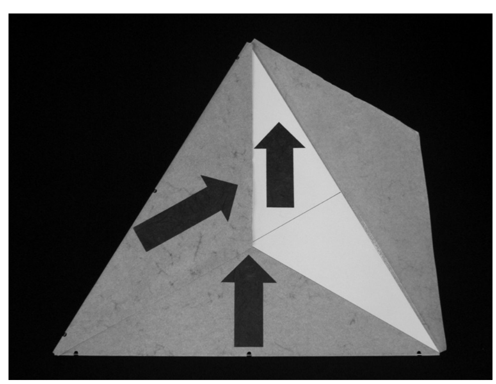


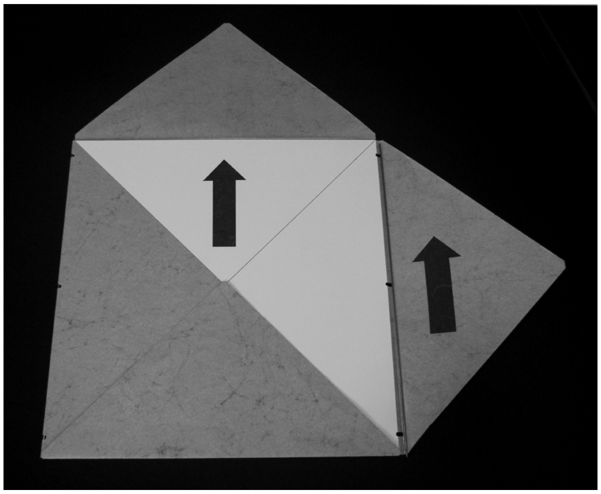
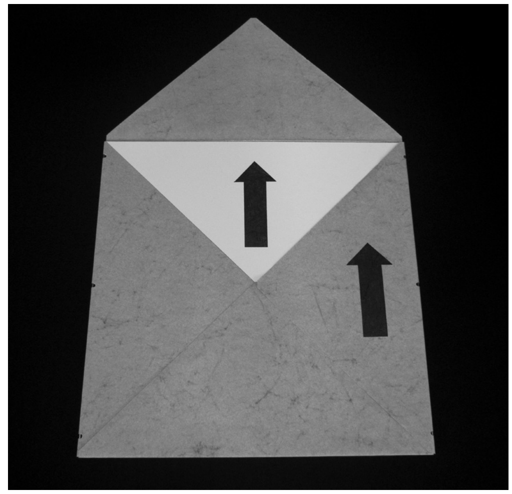


Construction techniques for each type of binding vary according to its particular form, but there is a common group of materials—used in most of the structures—that handle easily, perform beautifully, and take archival needs into consideration. The wire is usually stainless steel, though brass is useful especially when parts are soldered. Both paper and metal are used to wrap and finish core components, but always with compatibility, functionality, and durability considered. Finding the right thread is a challenge. It's my experience that most linen bookbinding thread available to us today exhibits an alarming variation in thickness along its length, along with way too many slubs. This results in a corresponding variation in strength. Given that there is no way to splice a thread broken during the binding of one of these books, linen thread was rejected due to its propensity (though slight) to break during knotting. In place of linen I have substituted braided thread, a.k.a. surgical suture. Available in about a dozen thicknesses, this thread is braided instead of twisted, and is made up of a large number of filaments of one of three fibers: silk, nylon, or dacron. Each of these materials has strengths and weaknesses. Nylon is a bit too stretchy. Silk has a great feel, can be dyed any color, and has a very high initial tensile strength, but degenerates and looses considerable strength and stability upon exposure to UV light, e.g. sunlight. Dacron (chemically similar to mylar) is extremely stable and strong, but cannot be dyed easily, and is so hard and sharp that it easily cuts into soft material, such as one's skin, when cinching knots.

The choice of paper, cloth, thread, or wire depends on structural as well as aesthetic concerns, but the choice of adhesive is almost exclusively dictated by material/structural requirements. As with traditional bookbinding, a smart move when laminating the outer wrap to the core board is to align the grain of the various paper based materials that are being joined. This is easy to achieve in rectangular and square configurations. If the grain is aligned in the initial lamination, all turn-ins and edge wraps will maintain that alignment. The same does not hold true in shapes with corner angles other than ninety degrees, such as triangles, pentagons, etc. In these shapes, even if the initial lamination is made with grain parallel, the edge wrapped layer will necessarily be crossed-grain to the core. This is strictly a matter of geometry.





When grain can remain parallel throughout, the materials may be joined with water based adhesives. The introduction of moisture into the paper causes a swelling of fibers, with a consequent increase in dimension across the grain. As the paper dries the swelling decreases, so the dimension shrinks back. Laminations produced using wet adhesives such as paste or PVA (polyvinyl acetate) will exhibit this fractional shift of dimension, but if a few rules are followed, the dried pieces have a good chance of being flat. These rules include keeping grain parallel in all layers, maintaining symmetry in the paper used on either side of the core board, and constraining the piece while drying with blotters. There are always exceptions to these rules, but when the shape of the core board shifts away from square corners, all bets are off. If, as mentioned before, cross-graining occurs necessarily in those shapes, and if wet adhesive is used, the resultant shape of the lamination will most likely be that of a potato chip, a shape also known as a saddle-back. In certain cases this shape can be accommodated, but this complex curve gives no straight edges for hinging, so is much more difficult to use.

Now, if a flat lamination is desirable, and cross-graining is present, then a nonaqueous adhesive is recommended. The class of nonaqueous, or dry mount, adhesives has two main groups appropriate for use with paper and paperboard—namely pressure sensitive and heat sensitive (thermoplastic) adhesives. The first group is best known through the familiar use of materials such as Scotch tape, masking tape, and duct tape. Rubber cement is also a member of this group, and has single-handedly and deservedly given the whole class the reputation of low stability and questionable permanence (it must remain sticky because if it dries, it fails). Rubber is just not stable enough for archival book work. If pressure sensitive adhesive must be used, choose one with an acrylic base. I do use pressure sensitive films. A call to Minnesota Mining and Manufacturing (3M) tape division technical support will reveal a good selection of acrylic films specified by thickness and hardness. Tell the technical representative what you are joining, and they will make recommendations. http://solutions.3m.com/wps/portal/3M/en_US/3M_Industrial/Tapes/Resources/3M-Pressure-Sensitive-Adhesives/

The class of adhesives that has become my favorite over the years is heat-activated (thermoplastic) film. In terms of production, cleanliness, and adaptability it offers great characteristics. Various brands are available in the U.S., such as Clearbond 2000, Fusion 4000, and Versamount. These are all nonaqueous copolymers of polyvinyl acetate (PVA) and polyethylene, so for good reason resemble the dry film of glue found around the lip of most PVA glue pots. They all melt and become tacky at about 180°F (82°C). They achieve a glue bond when pressed between two layers of paper and raised to at least that temperature. A dry mount press with heated platen is most often used, but a regular electric iron can be employed. Moisture will of course be driven out of the paper at elevated temperatures, so some shrinkage will occur. If a heated press large enough to cover the entire piece of paper is used, the paper will dry evenly and stay flat. An iron can cover only a small area of the paper at one time. Consequently, uneven drying may result, and the paper will cockle. To avoid this, the iron must be moved evenly and deliberately all over the paper, so that even heating and drying occurs.

All three adhesive films mentioned are advertised as archival, meaning that they are reversible and acid free. As with pressure sensitive adhesives, the reversibility issue is complex. The glue bond may be reversible, in this case with heat, but to remove all of the adhesive residue from both pieces of paper will be difficult to accomplish. One would probably need to resort to scraping the paper with a heated spatula. Because of this, I would be reluctant to call this an archivally reversible adhesive.

Now, as for acid free…Most discussions of acids and alkalis assume the presence of water. These thermoplastic films do not contain appreciable water, so to determine their acidity, one places a little water in contact with them for a set time, then measures the acidity or alkalinity induced by that contact. The three adhesives mentioned do not turn the water in contact with them acidic, so are considered acid free and safe to use. Not all thermoplastic adhesive films can make this claim. Some may contain chlorine in the form of polyvinyl chloride (PVC), so may be very detrimental to paper and metal. Other films are polyurethane or nylon (polyamide) based. Before using them, ask the manufacturer's technical representative questions concerning the specific materials involved.

Nylon films are available at fabric stores, under proprietary names such as Stitch Witchery or Wonder Under, and are used for stitchless hemming. Aside from the issue of compatibility with paper, the nylon films have a relatively high melting point (upwards of 300°F or 150°C), resulting in extreme drying of the paper so treated. Consequently, the only use I make of these nylon based adhesives is in paper backing fabric for use as bookcloth. Unlike Clearbond, Fusion, and Versamount which are solid films, the nylon films as sold are quite porous, allowing moisture to pass through them. This is an important feature for a paper-backed fabric that will ultimately be adhered with wet glue.

When using heat sensitive adhesives I almost always apply the film to large stock pieces of paper, from which the required sizes are cut. It is impossible to place accurately the film exactly along an edge of the paper. If the paper is cut to size first and the adhesive is applied overhanging, it will need to be trimmed back. Conversely, if the film does not fully cover the paper, the lamination will be incomplete. A folio of silicone release paper is always used when heating the film. The film does not permanently stick to the silicone, and it acts as a barrier to protect the interior of the dry mount press from the fluid, sticky glue.

There are of course many more production techniques and tricks required than I have enumerated here. Each style of wire edge binding is characterized by a unique form, which requires a specific combination of materials to achieve. This is offered as a general discussion of the topic. I teach a number of hands-on workshops of two to six days length specific to many of the wire edge configurations. Details concerning availability of these workshops can be found at www.GarageAnnexSchool.com and www.DanielKelm.com, as can examples of bindings utilizing the various styles.