



Stretchers and Strainers: Materials and Equipment

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Compiler: *Barbara A. Buckley*

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Historical and Original Stretchers and Strainers

Illustrated Historical Review of Stretchers and Strainers

“Note: An unsolved problem—to find simple appropriate names for each type of stretcher. My descriptions are obviously awkward. R.D.B.” (Buck 1972)

With this hand-written note on the front of his unpublished typescript, Richard Buck presented his seminal survey of stretcher designs categorized by joint types to a group of conservators at the 1972 International Council of Museums (ICOM) meeting in Madrid. Hundreds of photocopies later, Buck's paper now often includes the photocopied notes of our teachers and mentoring conservators from whom the paper was borrowed and copied. In 1992, Alexander Katlan reprinted an edited version of Buck's paper, thereby allowing it to be read and used by a wider audience.

It has been noted over the years since Mr. Buck's handout was made, that some of the terms used to describe stretcher joints are at variance with the terms used by furniture conservators and decorative arts scholars for similar joints used in cabinetmaking. In order to standardize the nomenclature for the various types of stretcher joinery, several books on furniture construction were consulted. Michael S. Podmaniczky, during his tenure as Senior Furniture Conservator at Winterthur Museum, was also consulted on the terminology for stretcher joints. The following illustrations provide the commonly used cabinetmaking terminology, as well as alternate terminology when applicable, in addition to the terminology offered by Buck that is now so commonly used by painting conservators. (It should also be noted that in Erica James's entry on keyed stretcher designs, section 1.1, in which the Buck terminology is used, the figure captions have been keyed by number to the illustrations in this section for the alternate terminology).

The illustrations in this section (and reproduced elsewhere throughout *Stretchers and Strainers*) have been drawn from several sources, including the 1972 Buck paper, in which the original illustrations were drawn by Ross Merrill and Norman Muller. Carolyn Tomkiewicz's study of Spanish colonial stretcher joints (see section 1.5) has provided many additional joint types. Other examples have been drawn from corner joints from the Winterthur/University of Delaware Program in Art Conservation (WUDPAC) collection of stretcher types for easel paintings as well as examples from the conservation files of the authors and other conservators. An attempt has been made to include a representative sampling of frequently encountered stretcher types as well as a few unusual examples of interest.

Buck's paper included “reported occurrences” of the stretcher types; these notations are included here as well. The reported occurrences listed with each illustration are Buck's unless otherwise noted. The following initials are used for stretcher joints supplied from the following sources:

- WUDPAC = Winterthur/University of Delaware Program in Art Conservation collection of stretcher types for easel paintings
- CT = Carolyn Tomkiewicz; see also section 1.5
- MB/BAB = conservation files of Mark Bockrath and Barbara A. Buckley

A space for notes was added so that the illustration section may be used as a workbook. It is anticipated that the illustrations will be added to and annotated in the notes field by conservators as they encounter other examples of interest in the course of their work. In this way, the original work started by Buck can be continued.

I would hope that more types of construction and more occurrences of types will be reported to a recognized data collecting center. With the cooperation of restorers and conservators in various parts of the world we should, in a few years, begin to attach to these various stretcher types a characteristic place and time of use by the weight of accumulated statistics and, eventually, to turn this new evidence toward tracing the history of a canvas painting. (Buck 1972)

Mark Bockrath and Barbara A. Buckley

Submitted June 2007

NOTES

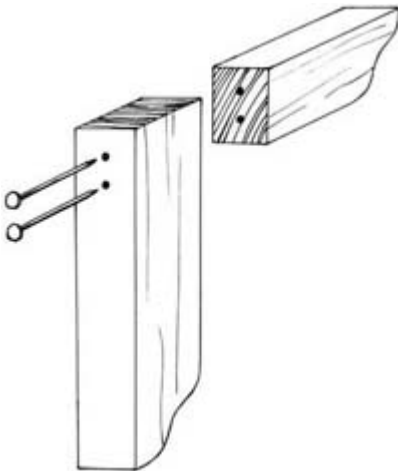


ILLUSTRATION 1 Butt joint with nails
BUCK Type 1a: Butt and Nail | Reported occurrences: American, 19th century

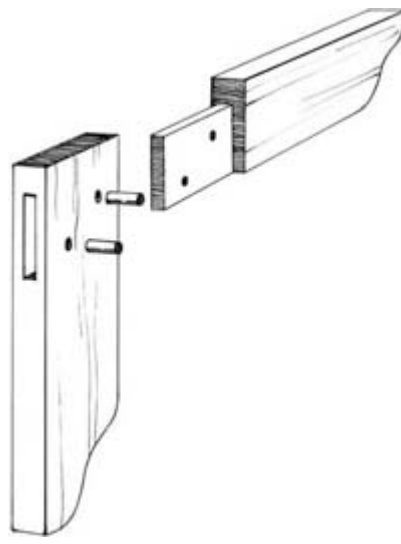


ILLUSTRATION 2 Mortise and through tenon joint, pinned

BUCK Type 1b: Mortise and pin | **Reported occurrences:** Copley, American, late 18th century

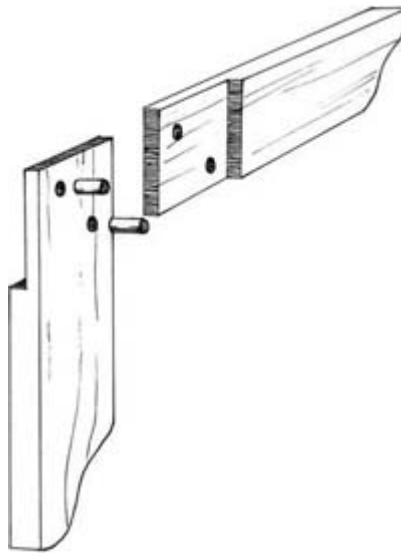


ILLUSTRATION 3 Half lap joint, pinned

BUCK: Type 1c: Half lap and pin | **Reported occurrences:** American portrait, about 1845; Ralph Earl, American, early 19th century

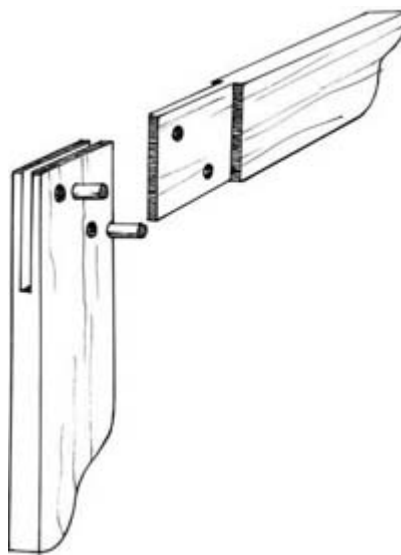


ILLUSTRATION 4 Bridle joint, pinned | Alternate: Slot mortise and tenon joint, pinned

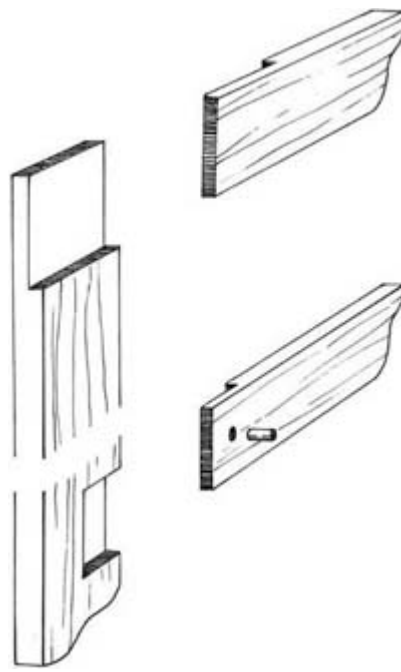


ILLUSTRATION 5 Half lap joint; cross-member with half lap joint, pinned

Reported occurrences: Cuzco school, c.1800 (CT)

NOTES: See also section 1.5, figure 17

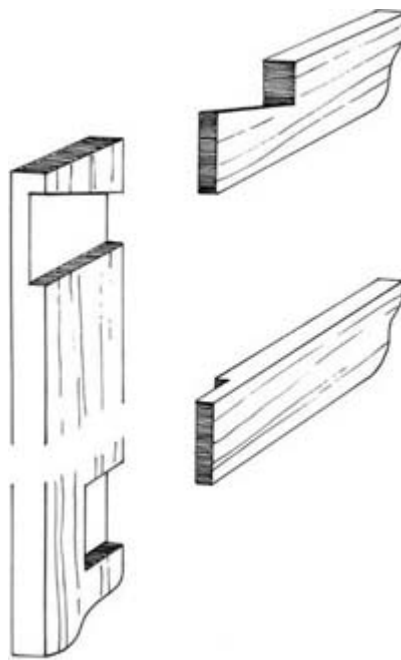


ILLUSTRATION 6 Dovetailed half lap joint; cross-member with half lap joint

Reported occurrences: Mexican, *The Martyrdom of San Felipe de Jesus* (BM44.47.2) (CT)

NOTES: See also section 1.5, figure 18

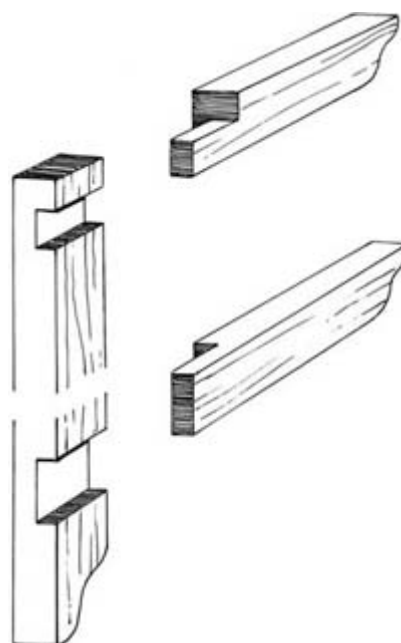


ILLUSTRATION 7 Shouldered half lap joint; cross-member with half lap joint

Reported occurrences: Mexican, 18th and/or 19th century (CT, courtesy of Camilla van Vooren, Western Center for the Conservation of Fine Arts)

NOTES: See also section 1.5, figure 19a

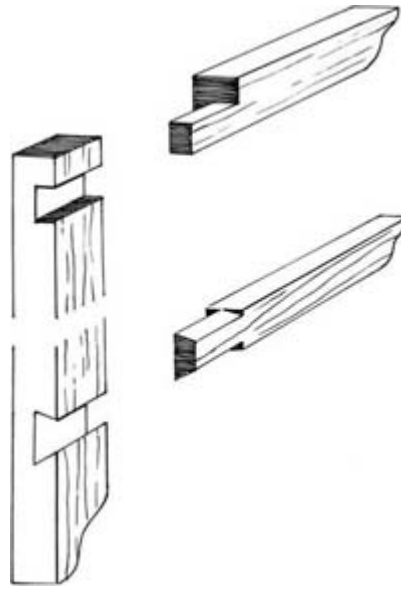


ILLUSTRATION 8 Shouldered half lap joint; cross-member with dovetailed half lap joint

Reported occurrences: Mexican, El Velo de Santa Veronica (BM45.128.37) (CT)

NOTES: See also section 1.5, figure 19b

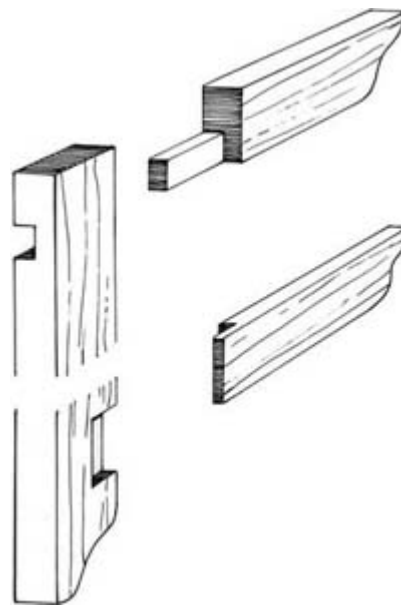


ILLUSTRATION 9 Reverse shouldered half lap joint; cross-member with half lap joint

Reported occurrences: Mexican, late 18th century, *St John Nepomuk, Priest in Confessional* (BM44.195.22) (CT)

NOTES: See also section 1.5, figure 21a

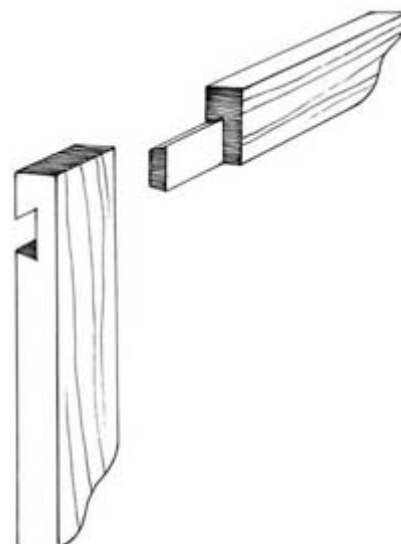


ILLUSTRATION 10 Dovetailed shouldered half lap joint

Reported occurrences: Mexican, *Untitled Crucifixion* (BM44.195.23) (CT)

NOTES: See also section 1.5, figure 21b

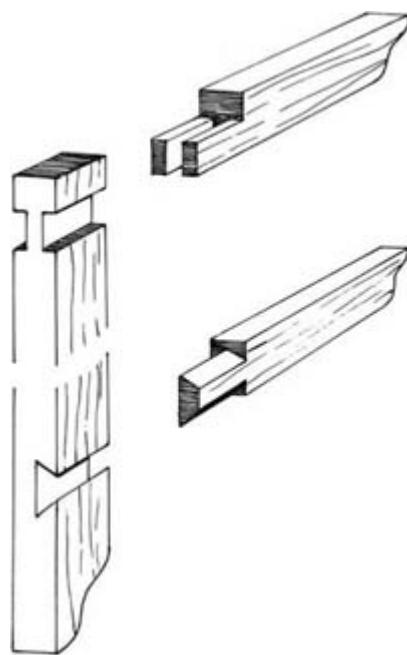


ILLUSTRATION 11a Shouldered bridle joint with dovetailed cross-member

Reported occurrences: Italian, 18th century (WUDPAC); Spanish colonial, 18th century (CT)

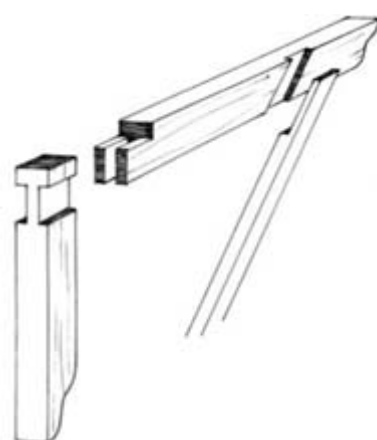


ILLUSTRATION 11b Shouldered bridle joint with corner brace

BUCK Type 6b: Double fork mortise with corner brace (variation with keyed brace) | **Reported occurrences:** Mexican, 17th century; Mexican, 18th century; Bassano (probably replacement)

NOTES: The original Buck illustration (11b) shows the non-keyed corner brace, although it is indicated that it has also been reported with a keyable corner brace. The construction is similar to illustration 11a (see also section 1.5 figure 22) but with the addition of a corner brace.

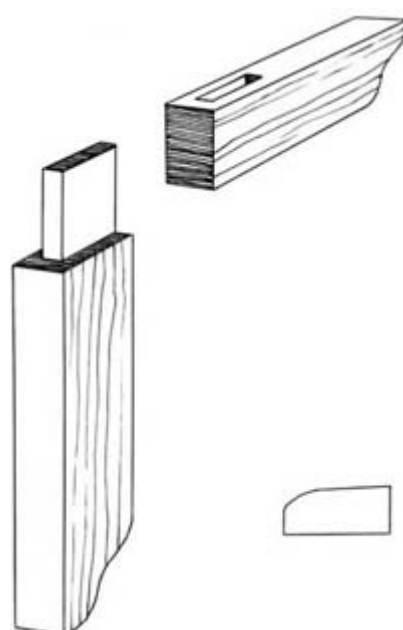


ILLUSTRATION 12 Mortise and through tenon joint

Reported occurrences: Italian, 17th century (WUDPAC)

NOTES: Hand-chamfered inner edge

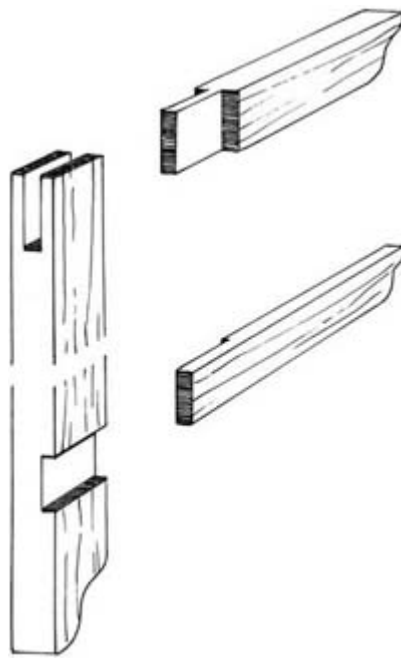


ILLUSTRATION 13 Bridle joint with half lapped cross-member | Alternate: Slot mortise and tenon joint; cross-member with half lap joint

Reported occurrences: Spanish colonial, late 18th century and early 19th century (CT)

NOTES: No slot for keys; see also section 1.5 figure 23

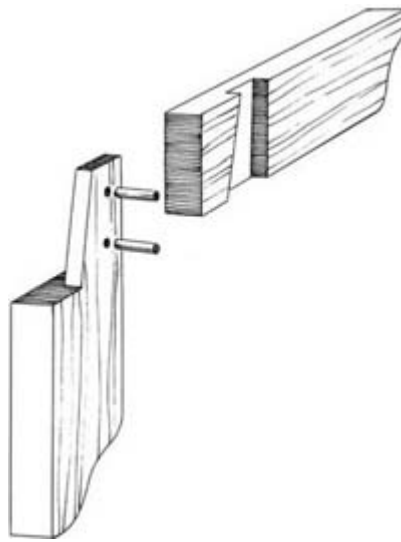


ILLUSTRATION 14 Angled shouldered half lap joint, pinned

Reported occurrences: Italian, 18th century (WUDPAC)

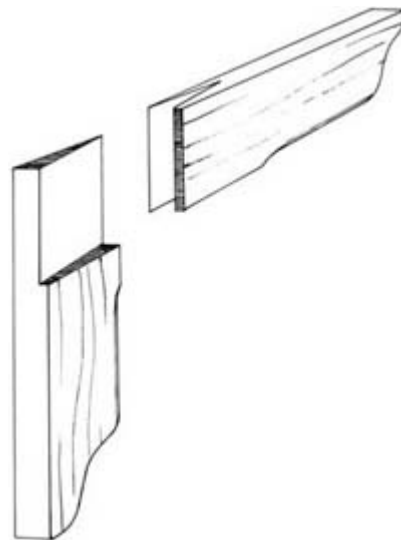


ILLUSTRATION 15 Tapered bridle joint

BUCK Type 1d: Wedge mortise and pin | **Reported occurrences:** American, 19th century

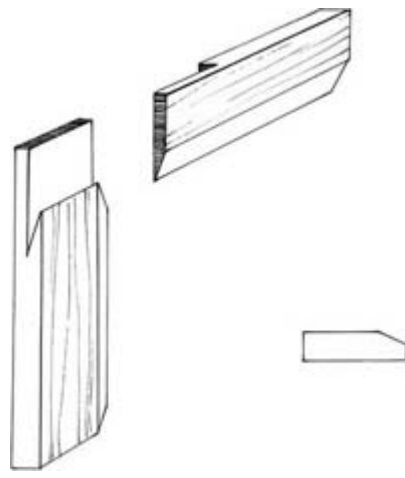


ILLUSTRATION 16 Half lap joint with beveled inner edge

Reported occurrences: Chinese export painting, c.1810 (Page, 1981)

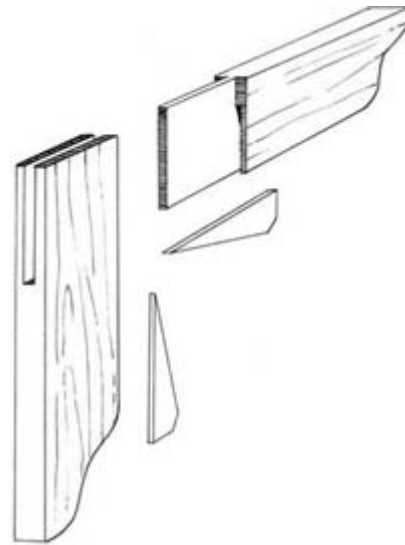


ILLUSTRATION 17 Bridle joint with keys | Alternate: Slot mortise and tenon joint with keys

BUCK Type 2a: Simple mortise and key | **Reported occurrences:** Chester Harding, American, c. 1821; Vigee-Lebrun, French; Miro, 20th century; Rembrandt (probably replacement), cross-member dovetailed

NOTES: Slots within joint for keys

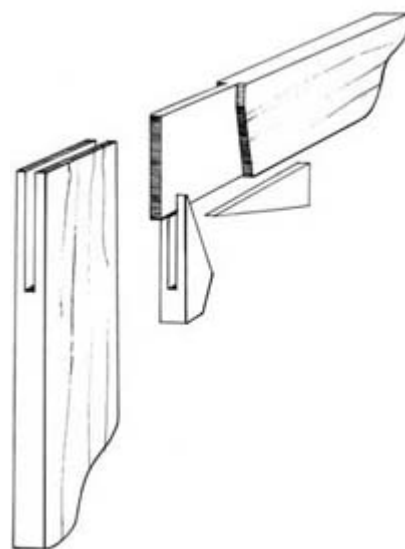


ILLUSTRATION 18 Bridle joint with interlocking keys | Alternate: Slot mortise and tenon joint with interlocking keys

BUCK Type 2b: Simple mortise with interlocking key | **Reported occurrences:** Italian, mid-19th century

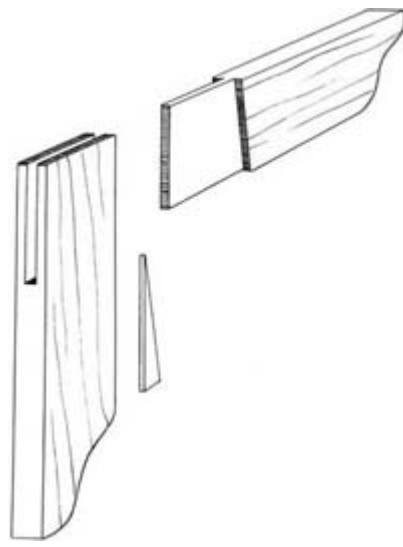


ILLUSTRATION 19 Bridle joint with key | Alternate: Slot mortise and tenon joint with key

Reported occurrences: American, 19th century (MB/BAB)

NOTES: One key per corner joint (not in a slot)

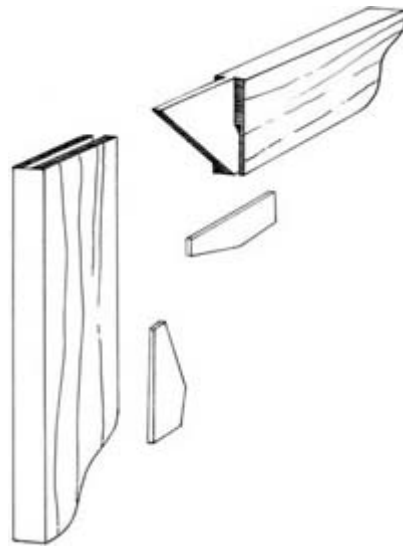


ILLUSTRATION 20 Bridle joint with mitered tenon and keys | Alternate: Slot mortise and mitered tenon joint with keys

BUCK Type 2c: Simple mortise, modified form with key | **Reported occurrences:** Waugh, American, 19th century

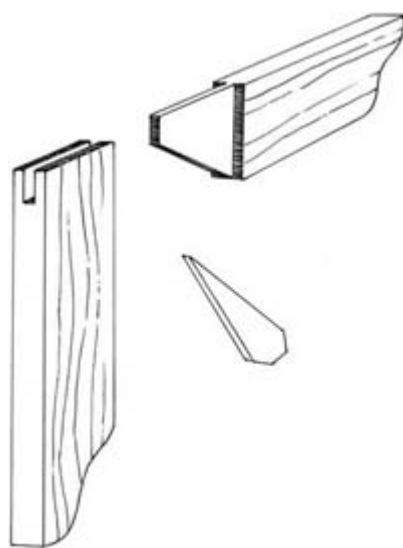


ILLUSTRATION 21 Bridle joint with mitered tenon (variation) and key | Alternate: Slot mortise and mitered tenon joint

BUCK Type 2c: Simple mortise, modified form (variation) with key | **Reported occurrences:** Felch, American, late 19th century

NOTES: Single key in joint

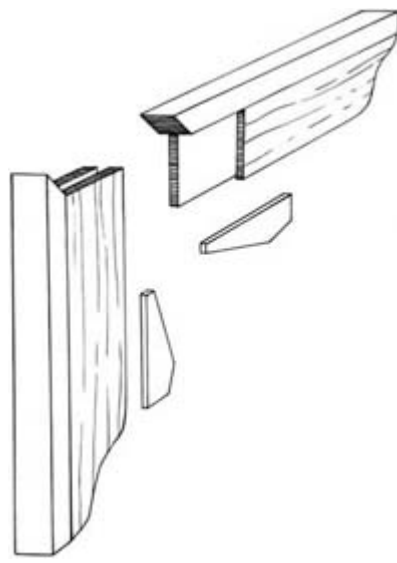


ILLUSTRATION 22 Closed bridge joint with mitered corner and keys

BUCK Type 2e: Simple mortise with extended bead and key | **Reported occurrences:** deHeem (stretcher bears stencil of Russian Imperial Collection, probably made in Russia); Bassano (probably replacement)

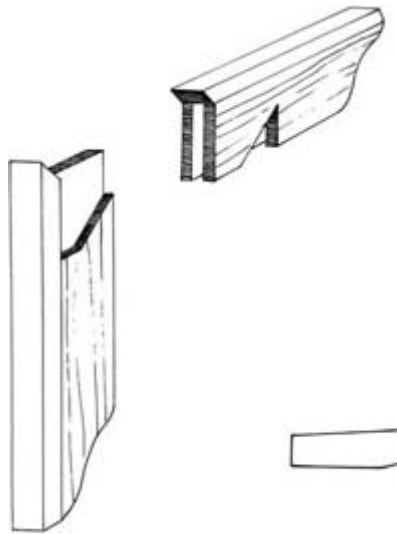


ILLUSTRATION 23 Closed bridge joint with mitered corner (notched variation)

Reported occurrences: American, 19th century (WUDPAC, courtesy of Peter Michaels 51.1980)

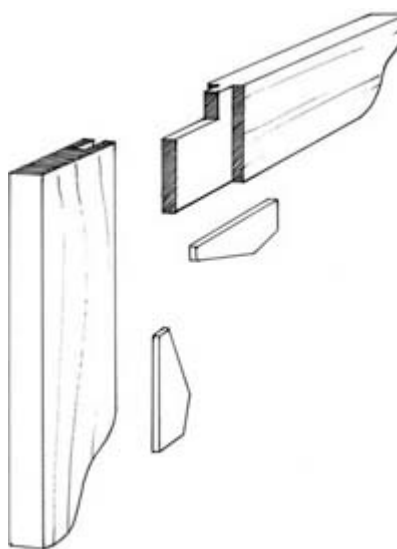


ILLUSTRATION 24 Haunched mortise and tenon joint with keys

BUCK Type 2d: Blind mortise and key | **Reported occurrences:** Sebastian Bourdon, French (probably replacement); Berthe Morisot, French, 19th century; Romanelli (probably replacement)

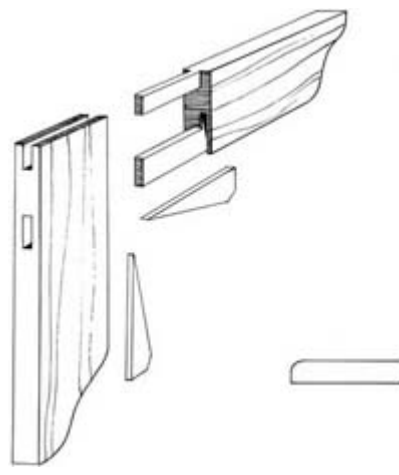


ILLUSTRATION 25 Double tenon with one bridled and one mortise joint and keys

Reported occurrences: R. Peale, American, 19th century (WUDPAC)

NOTES: Inner edge hand-chamfered

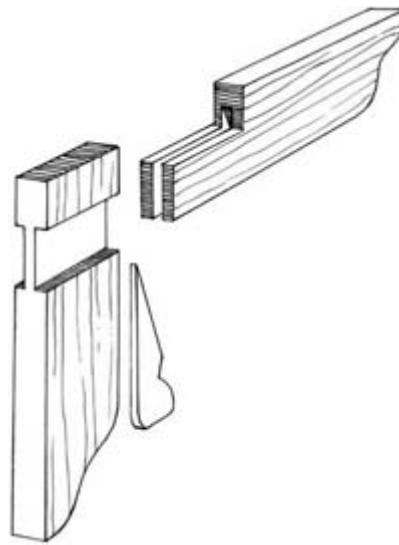


ILLUSTRATION 26 Shouldered bridled joint with key

Reported occurrences: American, 1870s (WUDPAC)

NOTES: Single key



ILLUSTRATION 27 Bridle joint with single key on oval stretcher; cross-member with mortise and tenon joint

Reported occurrences: 19th century (Purcell, 1999)

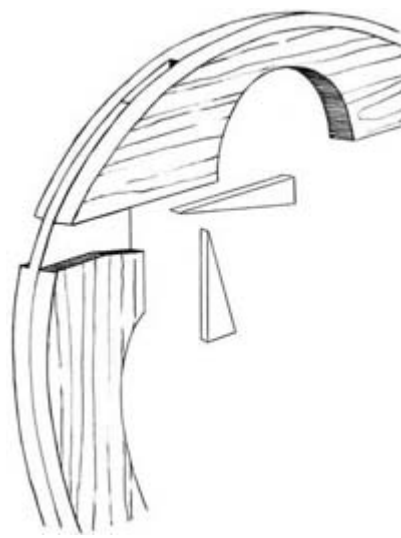


ILLUSTRATION 28 Bridle joint with keys on oval stretcher

Reported occurrences: American, 19th century (WUDPAC)

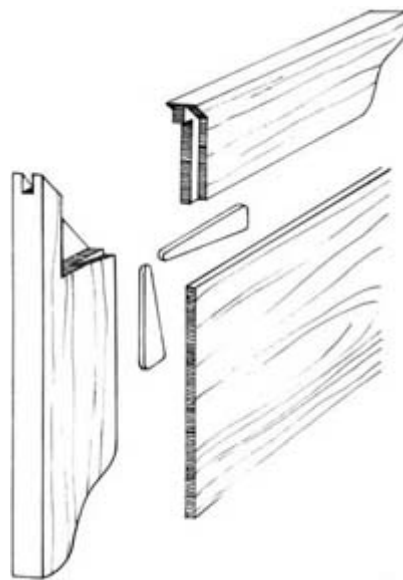


ILLUSTRATION 29 Panel stretcher with keys

Reported occurrences: Samuel Jennings, American, late 18th century (Winterthur Museum 58.120.2) (19th century replacement stretcher)

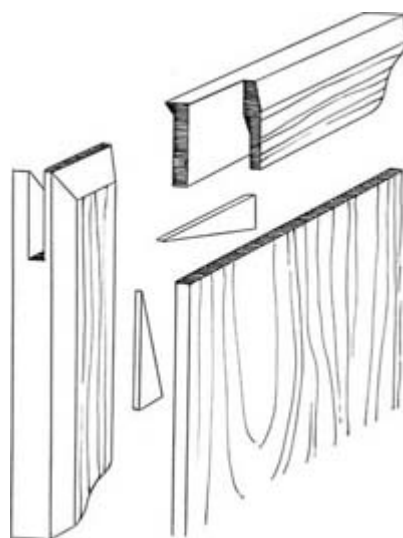


ILLUSTRATION 30 Panel stretcher with keys (obverse)

Reported occurrences: Albert Bierstadt, *Mt. St. Helens*, American, 19th century (WUDPAC, courtesy of Alan Farancz)

NOTES: See also illustration 31 (reverse)

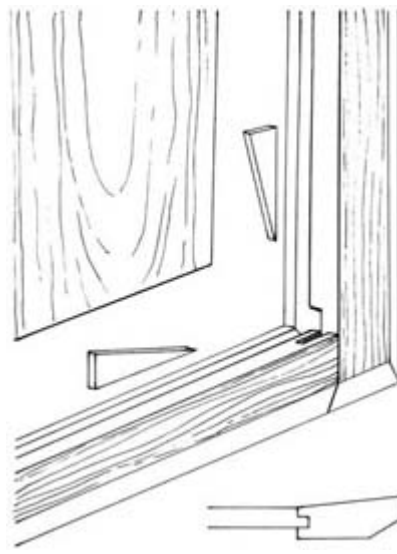


ILLUSTRATION 31 Panel stretcher with keys (reverse)

Reported occurrences: Albert Bierstadt, *Mt. St. Helens*, American, 19th century (WUDPAC, courtesy of Alan Farancz)

NOTES: See also illustration 30 (obverse)

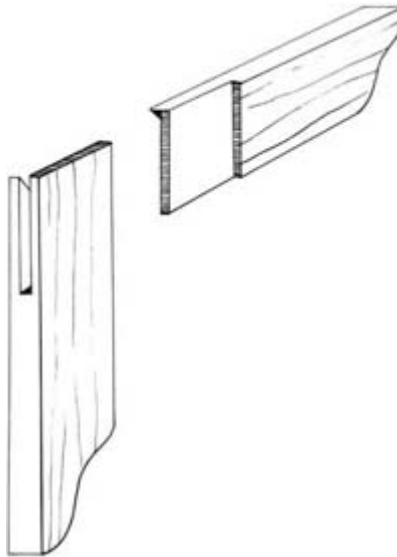


ILLUSTRATION 32 Half mitered bridge joint | Alternate: Half mitered slot mortise and tenon joint

Reported occurrences: Arthur Armstrong, American, 1830s (MB/BAB)

NOTES: No bevel and no slots for keys

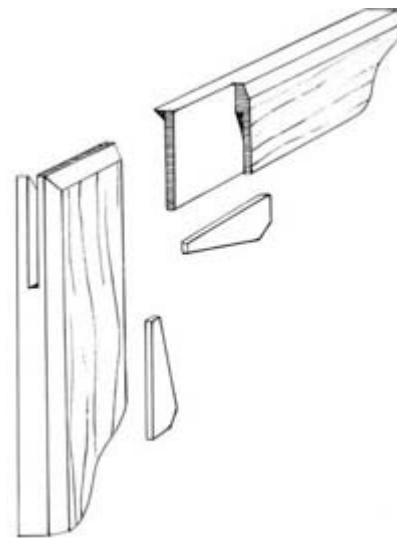


ILLUSTRATION 33 Half mitered bridge joint with keys

BUCK Type 3a: Mortise and half miter with key | **Reported occurrences:** Rattner, 20th century; James Peale, American, early 19th century; Luthy, American 19th century; Braque, French, early 20th century (double mortise and miter); Ernest Lawson, American, 20th century; Colormen Edward Dechaux and Theodore Kelley sold stretchers of this type from 1840 – 1860

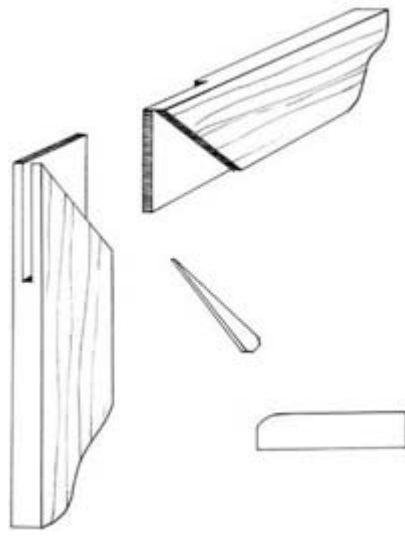


ILLUSTRATION 34a Half mitered bridle joint with single diagonal key
Reported occurrences: Jacob Eichholtz, American, 1814 (MB/BAB)

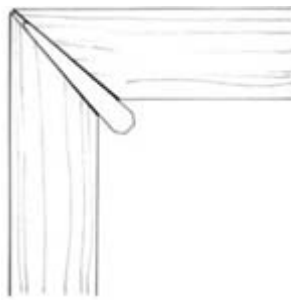


ILLUSTRATION 34b Assembled view

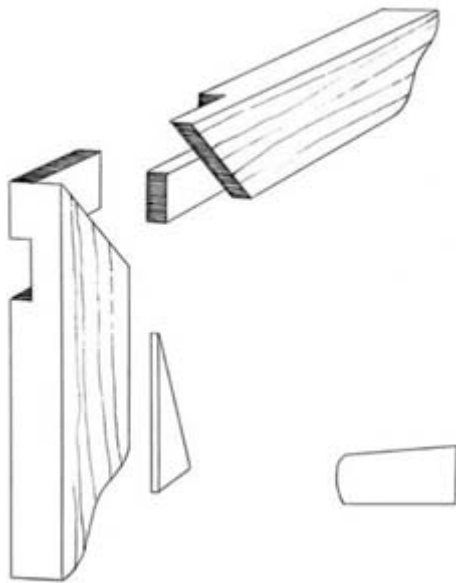


ILLUSTRATION 35 Mitered shouldered bridle joint with single key
Reported occurrences: Carl Rungius, American, early 20th century (WUDPAC)

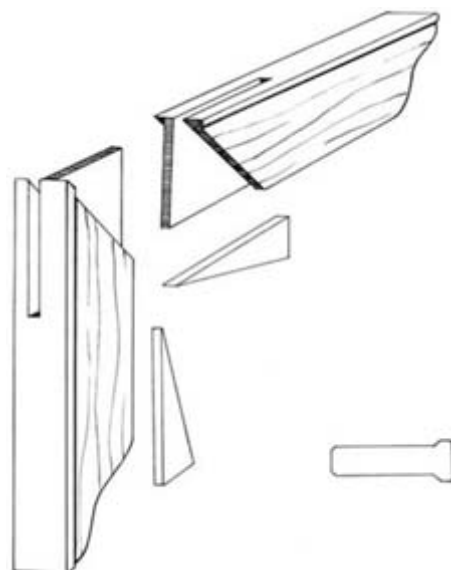


ILLUSTRATION 36 Full mitered bridle joint with keys | Alternate: Full mitered slot mortise and tenon joint with keys

BUCK Type 4a: Mortise with double miter and key | **Reported occurrences:** Schmidt-Rotluff, 20th century, Swiss trademark on stretcher

NOTES: “This design, except for the use of a single “U” shaped key, follows U.S. patent #335383 issued to Frank P. Pfleger, Joliet, Illinois, on February 2, 1886. It has been available under various trade names and some variation in stock size in assorted lengths in American art supply stores for many years, and has been used widely by American artists of the 20th century” (Buck 1972). The profile of the reversible stretcher members varies in production from a beaded edge to a beveled edge.

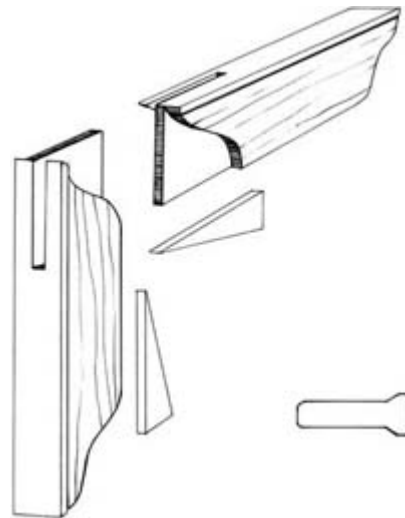


ILLUSTRATION 37 Full cyma mitered double bridle joint

BUCK Type 4b: Mortise with double miter, ogee variation with key | **Reported occurrences:** American, 19th century; William Schooner Howard, American, 1886 (WUDPAC, courtesy of Peter Michaels)

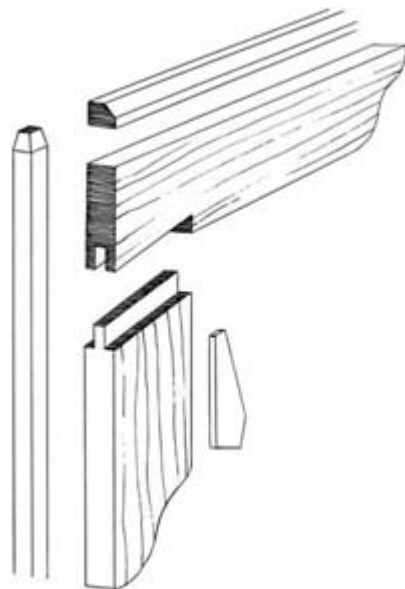


ILLUSTRATION 38 Angled tongue and groove joint

BUCK Type 5a: Tongue and groove ramp with key; rotary | **Reported occurrences:** A. M. Gorter, Dutch, 19th – 20th century; Edward Gay, American, 1856

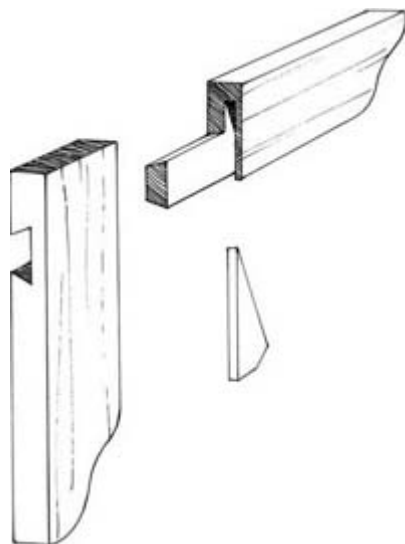


ILLUSTRATION 39 Sliding dovetailed shouldered half lap joint with single key

BUCK Type 6a: Single fork mortise, dovetailed and keyed, often rotary | **Reported occurrences:** Tharrats, Spanish, 1962

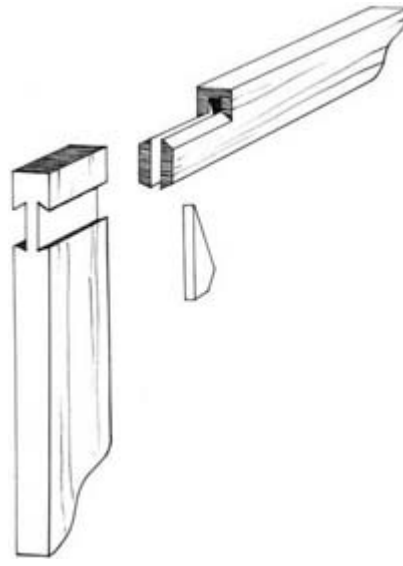


ILLUSTRATION 40 Shouldered dovetailed bridle joint with single key

BUCK Type 6c: Double fork mortise, dovetailed, keyed, often rotary | **Reported occurrences:** Rueda, Spanish, 20th century

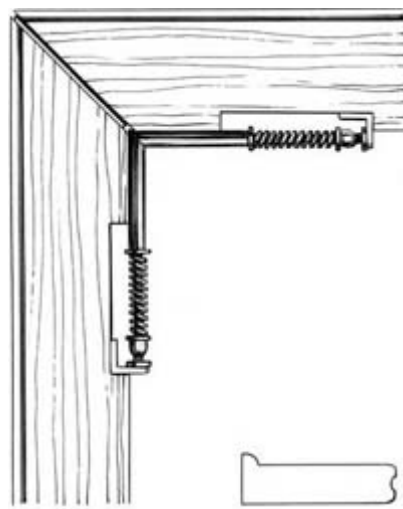


ILLUSTRATION 41a ICA Spring Stretcher with spring corner mechanism

NOTES: This spring tension stretcher design was developed by Richard Buck in the early 1950s at the Intermuseum Laboratory of the Intermuseum Conservation Association (ICA) in Oberlin, Ohio (see also section 2.3).

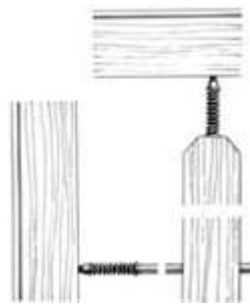


ILLUSTRATION 41b Cross-member mechanism

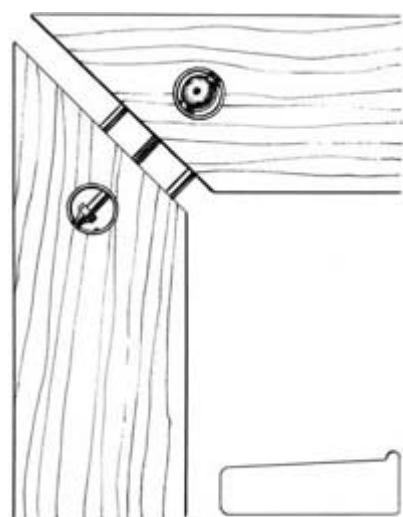


ILLUSTRATION 42 Expansion bolt stretcher

NOTES: Developed, but not patented, by James Lebron c.1957 and commonly called a Lebron stretcher. The stretcher members are made with either a beaded or beveled profile (see also section 2.2.

Historical Review of Joint-Adjusting Mechanisms

The shortcomings of the keyed stretcher must have been apparent as soon as the expandable stretcher was adopted by artists in the 18th century. The wooden keys split or broke off and, falling out of their grooves, lodged next to the canvas and caused distortions or, equally inconvenient, were lost. The hammer blows used to drive the keys, if they pressed against the relatively brittle grounded canvas, in time often showed themselves as lines or arcs of feathered cracks.

The other shortcoming of the plain keyed stretcher was the lack of control the artist had in the direction the wood members moved for better tension on the fabric. It is not surprising that less than a century after the introduction of the keyed stretcher, numerous patented stretchers with joint-adjusting mechanisms were made.

These patented devices, primarily American, are reviewed and illustrated in the two volumes by Alexander W. Katlan cited at the end of this entry. Anyone working with old easel paintings will need these for reference and, using them, will acknowledge the professional debt we owe Katlan for his research.

What follows is a survey of Katlan's published examples, with some additions to include further 20th century devices. This is not a substitute for referring to the Katlan volumes but is meant to be a handy dating list for some of the more frequently encountered examples.

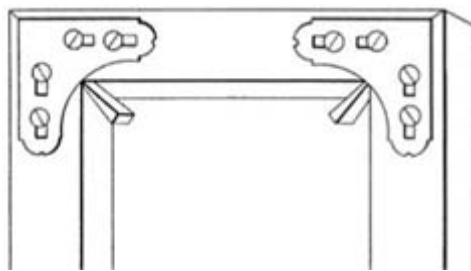


FIGURE 2 Mitered members without mortise and tenon, with keys for expansion and metal plates held with screws.

1849 | H. Bryant, Hartford, CT.

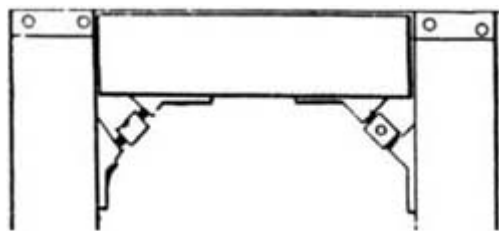


FIGURE 3 Halved or tenoned members with brackets attached to each member, each bracket accepting the threaded ends of a screw that is turned with an awl to either spread or draw together the members.

1868 | J. F. Carroll, Boston, MA.

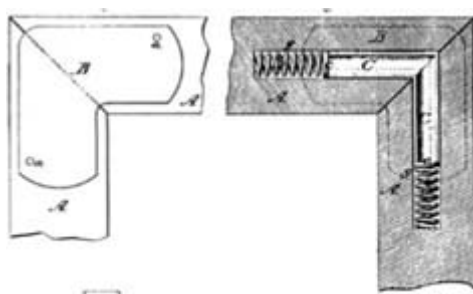


FIGURE 4 “Automatic Metallic Stretcher” with springs for tension and plates to prevent twisting at the joints.

1870 | J. D. Crocker, Norwich, CT.

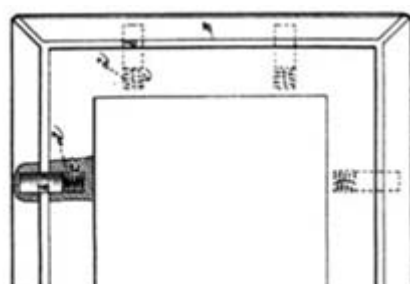


FIGURE 5 A rigid inner frame with an expanding outer frame that carries the canvas, with dowels and springs expanding the outer frame. The c.1990 Phillips stretcher is a refinement of this design.

1873 | H. W. Holly, Brooklyn, NY.

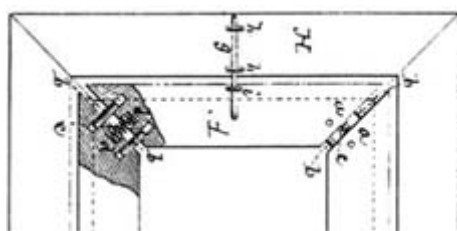


FIGURE 6 Dowels and a spring in a mitered joint for tension, stapled closed until the canvas is stretched, and sliding pins to hold the painting in a frame, allowing further expansion or contraction.

1875 | J. P. Wright and D. W. Gardner, Brooklyn, NY.

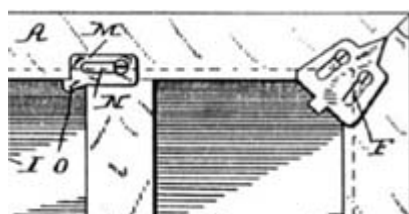


FIGURE 7a A combined plate and key for mitered joints. The 1885 modification was to accommodate stretchers with “panel-back or cross-bars, or both.”

1883, 1885, 1887 | A. D. Shattuck, Granby, CT.

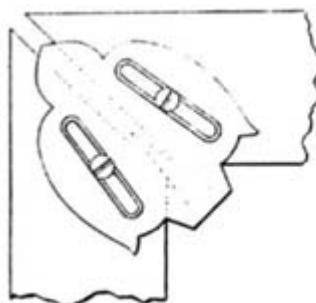


FIGURE 7b A combined plate and key for mitered joints. The 1885 modification was to accommodate stretchers with “panel-back or cross-bars, or both.”

1883, 1885, 1887 | A. D. Shattuck, Granby, CT.



FIGURE 8 The reversible stretcher members having the same profile front and back and the centered tenon with mitered mortise members allowed assembly of the stretcher in any order. This profile was later called the “Anco” stretcher, a later commercial use of the Pfleger design.

1886 | F. P. Pfleger, Joliet, IL.

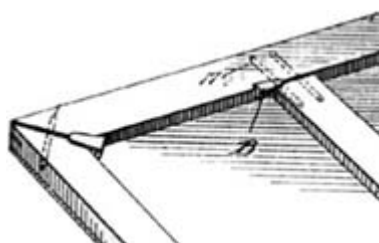


FIGURE 9a Corners fitted with metal rods, plates, and a metal key-wedge, also pins in the crossbars, and a cardboard on the face of the stretcher to support the canvas.

1900 | A. F. Tait, Yonkers, NY.

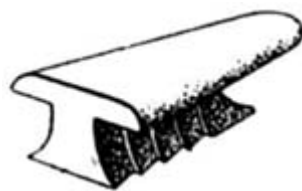


FIGURE 9b Corners fitted with metal rods, plates, and a metal key-wedge, also pins in the crossbars, and a cardboard on the face of the stretcher to support the canvas.

1900 | A. F. Tait, Yonkers, NY.

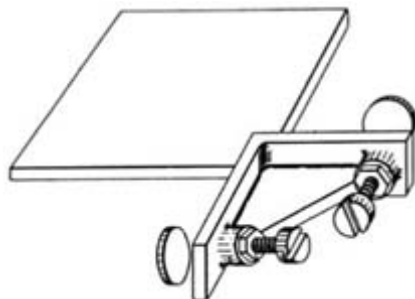


FIGURE 10 A cast [aluminum] plate with adjusting screws with lock nuts that press against metal discs on the wood members.

1949 | C. G. Bearce, Melrose, MA.



FIGURE 11 Usually redwood members with plates in the miters corners, spring braces in the inner corners, and a metal rod or springs in the cross members.

c. 1950 | R. Buck, Oberlin, OH, ICA Spring Stretcher. Not patented.



FIGURE 12 c. 1957 James Lebron, New York, NY, expansion bolt stretcher. Not patented.

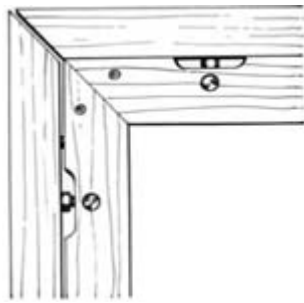


FIGURE 13 c. 1990 | Stan Phillips, North Egremont, MA. Not patented.

Michael L. Heslip
Submitted January 2007

Standard Stretcher Sizes

One will frequently see a number stenciled or stamped on the reverse of a painting support (fig. 14). This number refers to the standard stretcher size that was available to artists. The sizes were mentioned in France as early as the 17th century and to the present day, French stretchers conform to these dimensions. No other country appears to have established its own published charts nor do artists in other countries appear to refer to their paintings by number, as do the French. It remains unclear when similar conventions were adopted outside France; however, there are countries that presently refer to the table of standard dimensions as international sizes. The sizes are fixed but vary slightly from manufacturer to manufacturer. It is presumed that the French practice became more widespread in the 19th century when artists' materials became more available and French goods in particular were sought after. Stretchers were among the many items available.



FIGURE 14 Stenciled number refers to standard size of painting support.

Artists in France are recorded as buying ready primed and stretched canvas by the 17th century, and there is evidence that prepared artists' materials were generally available. Not until the 18th century, however, do we have any published mention of specific stretcher or strainer sizes. Antoine-Joseph Pernety published his *Dictionnaire portatif de peinture, sculpture, et gravure* in 1757 and in it referred to the sizes of the prepared and stretched canvases. He explained that the numbers assigned to the different sizes refer to the cost of the stretched canvas in sous. For example, a size 25 canvas would cost 25 sous. His publication presents the measurements in the prerevolutionary *pieds* and *pouces* (feet and inches) rather than centimeters. In the 1829–51 publication *Traité complet de la peinture* by Jacques-Nicolas Paillot de Montabert, a table of standard stretcher sizes was first introduced with numbers from 120 to 1. (Presently the numbers run in the opposite direction.) He continued to use *pieds* and *pouces*. By the time the 1850 and 1855 Lefranc catalogues were produced, the dimensions in *pieds* and *pouces* were published adjacent to the newer metric measurements. The standard sizes applied to both stretchers (*chassis à clefs*) as well as strainers (*chassis ordinaire*). The 1892 Lefranc Catalogue listed stretchers with and without fabric and in a variety of fabric types (fig. 15).

LEFRANC & C^{IE} * PARIS

CHASSIS NUS ET TOILES TENDUES SUR CHASSIS
POUR LA PEINTURE A L'HUILE

Nombres des toiles	MESURE d'un côté invariable	DIMENSIONS				CHASSIS NUS		CHASSIS TENDUS										Nombres des toiles
		PORTRAIT	PAYSAGE		MARINE		Portrait, paysage et marine	TOILE ORDINAIRE				TOILE 1/2 FINE		TOILE FINE				
			haut	bas	haute	basse		Châssis carré		Châssis ovale Ordinaire N° 114	Châssis carré		Châssis carré		Châssis ovale à Cles N° 119			
								Ordinaire N° 110	à Cles N° 111		Ordinaire N° 112	à Cles N° 113	Ordinaire N° 115	à Cles N° 116		Ordinaire N° 117	à Cles N° 118	
1	21 ^e 5 sur	16 ^e ou 14 ^e			11 ^e 5		» 20	» 40	» 60	» 65	1 50	» 70	» 75	» 75	» 90	3 50	1	
2	24.5 —	19 — 16			14		» 25	» 45	» 65	» 75	1 60	» 80	» 90	» 90	1 »	3 60	2	
3	27 —	21.5 — 19			16		» 30	» 50	» 70	» 90	1 75	» 90	1 »	1 »	1 25	3 75	3	
4	32.5 —	24.5 — 21.5			19		» 30	» 60	» 80	1 »	2 »	1 »	1 25	1 25	1 50	4 »	4	
5	35 —	28.5 — 27	24	21.5	18.9	» 32	» 70	» 90	1 25	2 25	1 25	1 50	1 50	1 50	1 75	4 50	5	
6	40.5 —	32.5 — 29.7	27	24	21.5	» 35	» 75	1 »	1 50	2 50	1 50	1 75	2 »	2 25	5 »	6	6	
8	46 —	38 — 35.1	32.5	29.7	27	» 40	» 80	1 30	1 75	3 »	1 75	2 25	2 50	2 75	6 »	8	8	
10	55 —	46 — 43.2	38	35.1	32.5	» 50	» 90	1 50	2 25	3 50	2 50	2 75	3 25	3 75	7 »	10	10	
12	61 —	50 — 45.9	43.2	40.5	38	» 60	1 »	1 80	2 50	4 »	2 75	3 25	3 75	4 25	8 »	12	12	
15	65 —	54 — 48.5	45.9	43.2	40.5	» 70	1 10	2 »	3 »	4 50	3 25	3 75	4 50	5 »	9 »	15	15	
20	73 —	59.5 — 56.7	54	51.3	48.5	» 80	1 25	2 50	3 50	5 50	3 75	4 25	5 25	5 75	10 50	20	20	
25	81 —	65 — 62.1	59	56.7	54	» 95	1 50	2 80	4 25	6 50	4 75	5 25	6 50	7 »	11 50	25	25	
30	92 —	73 — 70.2	67.5	64.8	62.1	1 20	1 75	3 30	5 25	7 50	5 75	6 50	8 »	8 50	14 »	30	30	
40	1.00 —	81 — 73		65		1 40	2 »	4 25	6 25	8 50	7 »	7 50	9 50	10 »	16 »	40	40	
50	1.16 —	89 — 81		73		1 80	2 50	5 25	7 50	10 50	9 »	9 50	12 »	12 75	19 »	50	50	
60	1.30 —	97 — 89		81		2 »	2 75	6 25	9 »	12 50	10 50	11 »	14 25	15 »	22 »	60	60	
80	1.46 —	1.13.4 — 97		89		3 »	3 50	8 20	11 50		14 »	14 50	19 »	19 75		80	80	
100	1.62 —	1.30 — 1.13.4		97		3 50	4 50	10 »	14 50		17 »	18 »	24 »	25 »		100	100	
120	1.94 —	1.30 — 1.13.4		97		4 »	6 »	12 »	18 »		21 »	22 »	29 »	31 »		120	120	

FIGURE 15 1892 Lefranc Catalogue listed stretchers with and without canvas.

Les chassis et toiles tendues kors mesure iont livrees dans les vingt-quatre /teures.

In addition to changing the measurements to the metric system, which took some time to be adopted by the color merchants following the second metrication law in France in 1837, the variations broadened. Whereas Paillot de Montabert only listed one format, by the middle of the 19th century, an artist could select a certain size stretcher in *figure*, *paysage*, or *marine* format; within these categories there were two *marine* and *paysage* formats for each size, offering five possible dimensions for each numbered size. Initially the *figure* format was referred to as *de mesure régulière* while *paysage* and *marine* were called *de fausse mesure*. Within a given size, one dimension of each format would always remain constant. For example, a size 25 *figure* stretcher would measure 81 cm x 65 cm, *paysage* would be 81 cm x 60 cm, and *marine* would be 81 cm x 54 cm. *Figure* format was always the largest, followed by *paysage* and *marine*.

The availability of standardized stretchers and the appearance of specialized color merchants were closely connected, and both seem to have developed fully by the last quarter of the 18th century. Artists, particularly in the 19th century, referred to their paintings by their size. Van Gogh, for example, wrote to his brother Theo in 1889 mentioning that he had 12 size 30 canvases in progress at once.

The source of the standard sizes has been questioned by many. Anthea Callen has done an exhaustive study relating the proportions of the dimensions to traditional harmonious relationships. Her results reveal that the ratios of width to depth do not conform to the golden section or dynamic symmetry as some have suggested, but rather to the ratios of static symmetry. A more probable source, however, for these sizes is purely practical. There was a fixed loom size that was available and this, of course, determined the width of a piece of fabric. Prior to the industrial revolution, the standard size was approximately 1 meter. Consequently this would dictate that the largest dimension of a piece of fabric in one direction would be no greater than the warp of the loom. It appears that there was a wider width for certain fabrics or weaves (damask, for example), which expanded the warp to 1 meter 40 cm. Subsequently the 1 meter 40 cm width became a standard loom size, and many of the standard stretcher sizes were based on this. When combined, several widths would approximate the 1 meter 40 cm dimension, suggesting that a group of small and large sizes may have been cut side by side across the loom width. It has long been noted that standard paper sizes conformed to the dimensions of the molds on which the pulp was formed, and the size of the individual sheets of paper was dictated by the number of folds (creating quartos, octos, etc.); it is not surprising that a practical convention and the manner in which it was divided would determine the dimension of the individual canvas support as well.

American manufacturing of artists' materials does not appear to have begun until the beginning of the 19th century. Prior to that, the American painters essentially followed English practices and purchased English manufactured goods. English standard sizes were initially referred to as full or half portrait, which were 80 x 50 inches or 40 x 50 inches respectively. There were also three-quarter or one-quarter length portraits, all of which were based on the 80 x 50-inch dimension. A well-documented standard size whose origin can be traced was referred to as the Kit Kat (or Kit Cat) size. This 36 x 28 inch format was the smallest of the portrait formats and derived from the series of portraits commissioned by the secretary of the Kit Kat Club, a dining club established at the end of the 17th century in London and frequented by members of the Whig party. The artist, Sir Godfrey Kneller, painted portraits of the club members from 1702–17. It has been suggested that the size of the 42 portraits (all the same size but one), depicting only the head and one hand, was determined by the number of portraits that would fit within the proportions of the room.

By the 1850s, English catalogues advertised standardized sizes for pre-stretched landscape and figure canvases. In the Winsor and Newton catalogue of 1851–57, landscape canvases were listed in sizes from 9 x 6 inches to 36 x 24 inches. Portrait canvases ranged from 8 x 6 inches to Bishop's Whole Length of 8 feet 10 inches x 5 feet 10 inches. The whole length or whole cloth size presumably referred to the full size of the fabric based on the loom dimensions. If one compares the English and French catalogues from the same date, it is evident that the French had a much broader range of sizes than the English.

Paillot de Montabert briefly mentioned the use of standard stretcher sizes outside of France and recalled that the artists with whom he spoke in Flanders did not use standard sizes nor did artists in Rome (and presumably in other parts of Italy). He continued to note that the only standard size observed in Rome was the *tela d'imperatore*, which was close to three feet in length. Presumably the width was determined by the Italian loom size, which ranged from 1 meter to 1.10m. This has been observed as a standard size in one dimension; on large Italian paintings, one can often recognize that seams occur at 1-meter intervals. Paillot de Montabert mentions that the *toile de prix* was similar to the *tela d'imperatore* and suggests that students were required to paint their entries for the art competitions using prescribed dimensions.

In 17th century Holland, cloth was measured by el, a measurement that varied from town to town. It generally ranged from 68–70 cm. Dutch paintings, which have often been studied, approximate this standard size. In a study of Vermeer's paintings, observations reveal different formats used for different subjects. These could be distinguished by the differences in height-to-width ratios. Prepared artists' materials existed in Holland and standard sizes occurred, but, again not with the standardization of the French charts or numbers to identify one size from another. By the 19th century, French color merchants had such influence on the market that in Holland, as in many other places, the French system was followed.

It appears that the origins of the standardized sizes cannot be traced to formal canons of proportion but rather to practical and economic considerations, and although the standard sizes may have been introduced before there was commercial activity among artists' colormen, they developed in tandem. Paillot de Montabert insisted that the standardized stretchers were established and continued for the convenience of the color merchants and framers. However, artists appreciated this convention as well. Vincent van Gogh, always eager to save money, wrote to his brother that they wouldn't need to purchase as many frames if the picture sizes were similar; he could buy standard frames to accommodate any number of pictures of the same dimensions.

Apart from the advantages for the commercial side, the standardization of stretcher sizes allowed artists to produce matching pendants and related images. Referring to the size of a painting has also been an aid to scholars who can identify a certain picture when it is referred to in letters or inventories by number, particularly when the title or the description seems unclear. Noting standard sizes allows scholars to recognize when the original dimensions of a painting have been altered. Frequently the existing size is close but not exactly the same as the standard sizes. In those cases, one can often presume that the proportions have been changed at a later date.

Currently, the standard measurements available are based on the French tables. As French colormen began to sell abroad, they introduced their stretcher sizes along with canvases, brushes, easels, and the like. Few artists, however, refer to their paintings by number, as do the French. The convention has changed little since first introduced.

Ann Hoenigswald

Submitted April 2007

Historical Review of Nails and Tacks

Introduction

Nails and tacks are generally slender metal devices used to join one material to another by impact insertion. They consist of a head to receive the impact, a shank or body to join the materials, and a point. Most general reference sources state that the earliest nails were hand-forged from copper, then bronze, and then iron. The size of a nail is classified by the “penny” because in medieval England nails were sold by the hundred. A twopenny (2d) nail—100 nails that sold for twopence—is one inch in length. A threepenny (3d) nail is 1 1/4 inches, and so forth up to a sixtypenny (60d) nail, which is 6 inches long.

More than 1,100 types and sizes of nails are manufactured. Although most are steel wire, both wire and cut nails are also made of such metals as aluminum, iron, brass, bronze, and copper. The wrought-iron nails once hand-forged by a blacksmith for shoeing horses are now made by machine from low-carbon steel. Nails come in a wide variety of forms, according to the purpose for which they are intended. Nails that are longer than six

inches are called spikes. Some nails can be driven into concrete or steel ingots. Galvanized, or zinc-coated, nails resist rusting. Other nails have a resinous coat that melts from friction, forming a strong bond with the wood. Some nails have spiral shanks, like screws, or deformed shanks for a better grip (*Compton's Encyclopedia*).

Much of the research on the history of nails has been conducted by architectural historians who hoped to be able to date buildings. Painting conservators have the same goal when studying nails and tacks found in panel paintings or on the tacking edges of canvas paintings. Both have learned that overlapping technologies prevent the study of nails and tacks from being the sole means of identifying the date of manufacture of an item. As architectural historians have used nails as one of several age indicators, so has the author used them in conjunction with wood identification and X-radiography to judge fabrication dates (Goist et al. 1988, 165–172). It is possible that techniques other than visual examination can help to date the manufacture of nails. One study used metallography in an attempt to develop a chronology (Geselowitz et al. 1991).

Conservators of paintings have documented wooden tacks found used on the edges of at least three dozen early 18th-century American paintings from the Hudson River Valley, Philadelphia, and Jamestown, Virginia (Quandt 1971, 355). When one retrieves wooden tacks from old strainers, a task that is often difficult because they have no heads, they are found to have the appearance and hard—almost waxy—surface of thorns. Identification of the wood by microscopic analysis is difficult because the tacks are highly resistant to cutting (Quandt 1971, 355).

Hand-Forged/Wrought Iron Nails

Hand-forged nails are characterized by a square shank that tapers, often to a point, and a multifaceted head formed by multiple blows from a hammer while the red hot nail rod is held in a heading tool:

Historically, the nail-making process began with the smelting of iron ore into large cast “pigs,” which were then remelted and stirred in a process that reduced the carbon content, thus making it forgeable into large bars of wrought iron. When such bar iron was imported (primarily from Sweden), it was often converted for other uses in rolling and slitting mills....By hot rolling the bars into successively smaller sizes, they could be used for a variety of needs, such as iron railings, gates, hinges, or nail plates. Nail plates were rolled to make them narrower and thinner so that they could be run through a slitting mill, thus slitting the plate into long, narrow strips called nail rods, usually about 1/4" square....The blacksmith could put several nail rods into his forge, heat them up, and easily cut them into shorter “blanks” of a workable length. These blanks could then be forged, quickly and efficiently, and made into nails by heating, pointing, cutting, and heading. (Nelson 1991, 18)

The earliest examples of hand-wrought nails a painting conservator is likely to encounter are found in early European panel paintings. In the early 1400s, Cennino Cennini in *Il Libro dell'Arte* (Cennini 1960, 69) advises to cover nail heads with tin foil to prevent the iron from rusting and staining gesso. The nails and foil can be identified within panels by X-ray radiography. The protruding points are often clinched or bent over on the reverse. Nails can also be found holding engaged frame moldings to panels and at the corner joints of strainers and frames.

Nails were an important commodity in colonial America. Many were imported, but a native industry of small shops did develop. By 1789, a tariff was enacted by Congress on many imported items, including nails, for the “encouragement and protection of manufactures.” Hand-forged nails remained available long after cut nails were widely used in the 19th century. In carpentry, wrought nails continued to be preferred for certain tasks, especially when clinching was required. Therefore, it could be supposed that hand-forged, clinched nails might be found in the corners and crossbars of a strainer support long after cut nails became available. George Bisacca has observed that in economically depressed regions, such as early 20th-century Italy, hand-forged nails were more affordable than machine-made ones (Bisacca 1990, 1999). A “Wrought-Head Decor Nail” (5/8 inch in length with a 3/8 inch-wide head) is still available from the Tremont Nail Company. It is also possible that a person with intent to deceive can reuse antique hand-wrought nails or tacks in a fake painting.

Machine-Cut Nails

A variety of sources indicate that the first cold cut nails were made in 1777 by Jeremiah Wilkinson of Cumberland, Rhode Island. “The period 1790–1830 encompasses a remarkable transition from wrought to cut nails” (Nelson 1968, 4). Many patents were issued during that period for improvements on nail cutting machines. However, due to the 1836 fire in the U. S. Patent Office, much primary source information was lost. Maureen Phillips has written on the competitiveness of inventors seeking patents for their nail cutting machines during the late 18th and early 19th centuries (Phillips 1996, 47–56). “Cut nails manufactured after c. 1830 are virtually undistinguishable from those made today” (Nelson 1968, 9).

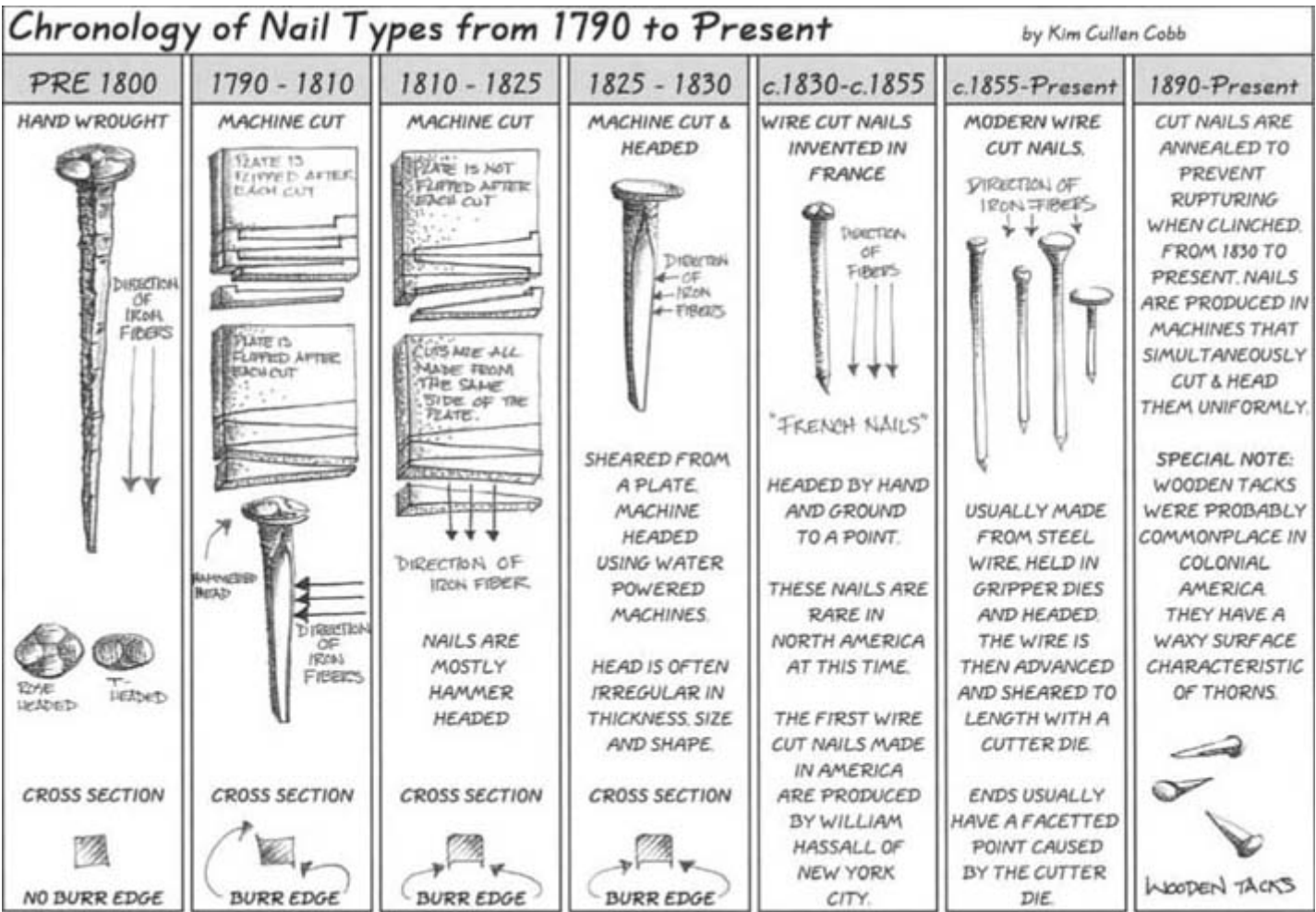


ILLUSTRATION 43

Early machine-cut nails had handmade heads usually featuring two facets. The shanks, which taper on two sides, in profile being more rectangular than the hand-forged type, were cut from plates that left burrs on the downward stroke of the shear. Earlier machines wiggled the plate to create the tapers while later ones flipped the plate. Smaller cut nails were called “sprigs” and “brads” that at one time had L-shaped heads. The many subtle variations of cut nails, sprigs, and brads can be reviewed in the American Association for State and Local History Technical Leaflet 48 titled

Nail Chronology as an Aid to Dating Old Buildings by Lee H. Nelson (1968). The leaflet is still available from the Nashville, Tennessee, office (615-255-2971) as a photocopy. Its hand-drawn illustrations are very informative. Maureen Phillips has published a revision of New England's cut nail chronology before 1820 with a useful table describing hand-wrought nails, 17th through early 19th century, to modern machine-cut nails, c.1835–c.1890 (Phillips 1994, 9).

The Tremont Nail Company, Mansfield, Massachusetts, established in 1819 (now a division of Acorn Manufacturing Co. Inc.), has been producing cut nails on the same machines in a factory completed in 1848. A sample set of 20 varieties is available as well as a free catalogue (800-842-0560 or see Tremont Nail Company (<http://www.tremontnail.com>)).

Wire Nails

“The term wire nail applies both to the present day machine-made nail using wire stock and earlier nails which used wire stock but may not have been made entirely with the use of machines” (Priess 1973, 87). The development of the technology for machine-made wire nails occurred in France in the early 19th century. A French author “lists French patents for wire nails beginning in 1806 and including at least seven up to 1825. Among these early patents is one registered in 1811 by James White, an American resident of Paris, for a machine that cut, head and point a nail in one operation” (Priess 1973, 87). Priess goes on to list various attributions to the beginning of wire-nail manufacture in America as 1851, 1870, and 1875 (Priess 1973, 88).

According to Nelson,

The earliest wire nails were not made for building construction, but rather in the smaller sizes for pocket book frames, cigar boxes, etc.....Wire nails did not supplant cut nails with the rapidity that wrought nails were replaced....Wire nails did not really become the dominant type until the 1890s....The greater holding power of cut nails was certainly a factor which delayed the quick acceptance of wire nails. (Nelson 1968, 10)

Common nails have a flat circular head. Finishing nails have a smaller head than the common type, much like a swelling at the top, meant to be driven below the wood surface by a nail set tool.

A painting conservator is less likely to find wire nails securing canvas tacking edges to stretchers because of their generally smaller surface area or lack of surface area at the underside of the head (except for a roofing nail). The author has observed the use of wire finishing nails bent over at an angle securing the tacking edges of lining canvases applied in the 20th century. Alexander Katlan reports finding bent wire nails (sprigs) without a head on paintings “from the mid- to late 19th century” with a specific example of *The Lone Hunter* (1886) by the Russian painter Medem (Katlan 1995).

Tacks

The Merriam Webster Collegiate Dictionary states that the word first appeared in 1574. It is based on the Middle English “tak” meaning “something that attaches; akin to Middle Dutch tac, sharp point.” It is currently defined as “a small short sharp-pointed nail usually having a broad flat head.” The term today usually applies to blued tacks. Formerly, carpet tacks had thicker shanks and wider heads whereas upholstery tacks had thinner shanks and smaller heads. These devices are the most common means of attaching canvas to wooden stretchers and strainers in the second half of the 19th century and the 20th century.

When the first machine-made carpet tack was produced is not clear. Maureen Phillips has observed that the early hand-operated machines that cut small nails also appear to have been used for cutting tacks (#ref94Phillips 1999). An 1872 publication devotes a chapter to “Small Nails and Tacks”:

Ezekial Reed, of Bridgewater, invented, about 1786, a machine for cutting tacks and nails, which, being improved, was used at Abington, making in 1815 one hundred and fifty million tacks. Jesse Reed, a son of the preceding, patented in 1807, a machine for making and heading tacks at one operation, at the rate of sixty thousand a day.... The business, however, having been thus established, in 1817 a patent was granted to Samuel Rogers and Thomas Blanchard, of Boston, Mass. This machine, known as the Blanchard machine, has with Reed's, above mentioned, superseded all others. (Greeley et al. 1872, 1074)

The text goes on to discuss a representative company, A. Field & Sons in Taunton, Massachusetts, which used about 225 machines of the Blanchard and Reed patterns. “The range of their manufacture includes about a thousand varieties of small nails and tacks, which are made of iron, zinc, copper, steel, and in fact, from every variety of material used for this purpose” (Greeley et al. 1872, 1077).

At the turn of the century, there were reported to be approximately 90 tack companies. The author has pulled tacks as short as 1/4 inch from a c.1825 unlined American painting, although 2-inch and 3/4-inch lengths are more common in the 19th and 20th centuries. Today, the Holland Manufacturing Company of Baltimore, Maryland, and D. B. Gurney Company of Massachusetts are the only two in America making carpet and upholstery tacks. The Holland Company makes blued tacks ranging from a #2, 1/4 inch to a #24, 1 inch in length. The family-owned company still uses turn-of-the-century, Perkins tack machines (Holland 1997, 1998). Mr. Richard Holland described the manufacturing technique as follows:

1. Material arrives as 36-inch wide x 30-inch long steel sheets.
1. They cut strips parallel to the 36-inch side whose width is approximately the length of the tack to be made.
1. Once fed into the tack machine, small wedge-shaped pieces are cut from the end of the strips.
1. The machine then transfers these pieces to an area where they are gripped, one at a time, by a set of shank forming dies.
1. The “header” then mashes the remaining material on the end, while the gripper holds the wedge-shaped piece. The heads can be irregular in shape.
1. “Bluing” is an attempt to sterilize the tacks for upholsterers who put them in their mouths so they could be picked off the tongue with a magnetic hammer. The process consists of a water wash followed by the “bluer” (a tube heated by gas to 600°F.). The heating does not change the metal but turns it blue. If not heated to the correct temperature, the surface of the tack appears grey. The bluing process began in the 1920s and was the accepted standard by 1930.

Mr. Holland stated that there are some small forming differences between British- and American-made tacks. Greater differences exist in the rest of Europe and the world in general. Some European and Asian tacks are made from square-rolled wire and are not at all like American cut tacks.

The D. B. Gurney Company of Whitman, Massachusetts, was established in 1825. They made cut tacks from plates but now produce shoe tacks. Tower Manufacturing of Madison, Indiana, sells blued tacks that are made outside the United States. The company still makes aluminum and copper tacks.

Other types of tacks are those commonly called “thumb tacks.” They have slightly convex heads whose diameter usually equals the length of the pointed pin shank. The heads are polished, painted, or coated. The author has rarely found thumb tacks used on tacking edges, so no research was attempted. One type of thumb tack was found on the tacking edge of an unlined American painting dated 1857, along with upholstery tacks. The

thin, pointed shaft was formed by stamping a thin wedge through the head leaving a negative space. On the head was stamped KEUFFEL & ESSER CO. N.Y.

Author's note: The author wishes to thank George Fore, architectural conservator, for providing a number of articles and for his advice. Alexander Katlan also shared some data gathered by his Class of Advanced Examination of Works of Art at N.Y.U. Appraisal Studies.

David Goist

Submitted October 2004

Historical Review of South American and Spanish Colonial Stretchers

Over seventy paintings by unknown artists of Peru and Bolivia dated 17th century and 18th century and of Mexico dated 18th century and 19th century in the collection of the Brooklyn Museum (BM) were reviewed. Of these examples, forty-five were selected for further examination and documentation since their condition had not been altered by subsequent restoration. The present entry focuses on stretcher/strainer types and their typical construction, joinery, and the characteristic fabric mounting methods. This survey communicates dates as found recorded in curatorial files and makes no attempt at dating material that requires further study. The information on secondary support gathered from paintings in the Brooklyn Museum collection is substantiated and/or supplemented by material examined at the Western Center for the Conservation of Fine Arts (van Vooren 2000) and the Fundacion Tarea, Buenos Aires, Argentina (Orlandini 2000).

Various methods of mounting paintings to secondary supports were recorded during this survey. These include:

1. Adhering painted fabric overall with glue to a softwood, hand-hewn, wooden panel, as in *Crucifix on Altar* (BM#45.128.190), measuring 28-1/4" x 16-3/4" x 9/16";
1. Attaching painted fabric with wooden pegs or metal nails to a dowel at the bottom and to a painted wooden case at the top into which the painting is then rolled for transport, called traveling scrolls (fig. 16), as in *Traveling Altar* (BM#42.54);
1. Adhering fabric to the face of a strainer with glue followed by ground application and painting (Querejazu 1986);
1. Stretching fabric onto a stretcher by means of tacks along a tacking margin in the conventional sense; and
1. Using wood as the primary painting support sandwiched between a painted frame molding and a strainer.

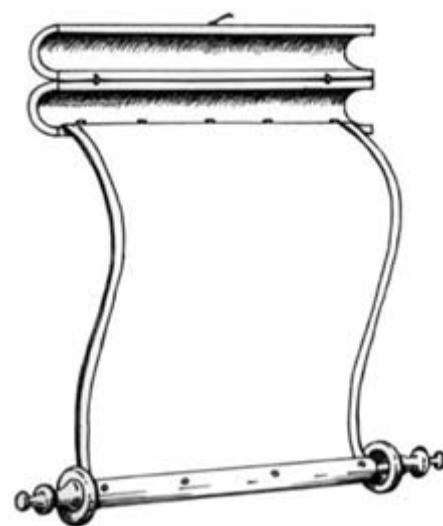


FIGURE 16 Traveling scroll for *Traveling Altar* (BM#42.54)

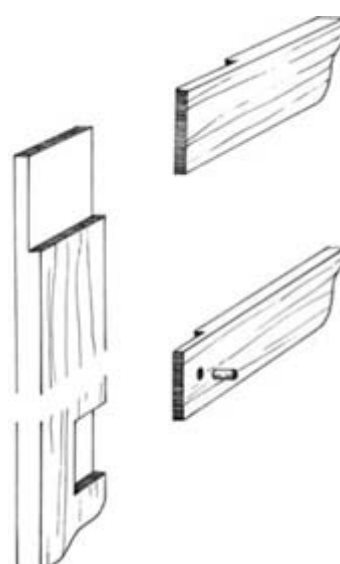


FIGURE 17 Pinned half lap joint (5)

The most common secondary support in this study is the fixed strainer (figs. 17–23). *Crucifixion with John and Mary* (BM#45.128.193) by an unknown Mexican artist comprises four planks held together by hidden internal dowels. The frame molding shows half lap joints (fig. 17) and is doweled to the face of the painting. The secondary support is a strainer with simple mortise and tenon (fig. 23) corner joints and three horizontal crossbars with fixed half lap joints that do not extend across the entire width of the outer members. The strainer is doweled to the reverse of the painted planks by regularly placed pegs. Fourteen depictions of Inca kings (BM#1995.29.1-.14), dated around 1800 of the Cuzco school, were examined.

These examples of Peruvian paintings confirm earlier documented findings (Querejazu 1986, 78–82), where coarsely woven fabric (22 x 33 threads/in.) is adhered with aqueous natural glue paste to the face of the strainer. In the case of these fourteen paintings, the fabric is wrapped around the strainer and adhered with the same adhesive along the sides and irregularly on the reverse. The strainer is a five-member, half lap joint¹ construction (Buck 1972) fixed with natural glue and small wooden pegs (fig. 17) at all sites of joinery.

Two holes penetrating the center of the top stretcher member from back to front still carry a twisted, double-knotted cord for hanging; the holes do not perforate the painted surface. The wide-grain, softwood strainer members show signs of being worked by hand at the joints, along the reverse surface where irregular saw cuts are noted and along the inner edge of some of the outer members to create a bevel and protective distance from the canvas. These strainers measure approximately 24" x 22" and are only 1/4" thick, which accounts for their fragility.

Likely due to a scarcity of fabric, most examples in this study show the fabric adhered to the face of the strainer often shy of the outer edge. The ground and paint applications are continuous to the outer edge, bridging the gap between the canvas edge and the secondary support edge. The depiction of *Santiago* (BM#45.128.27), attributed to an unknown Mexican, is painted on a coarsely woven canvas (28 x 30 threads/in.) adhered across the face to the outer edges of a five-member, half lap joint strainer (8 3/16" x 5 7/8" x 3/8"). In this case, no pegs accompany the glued joints and the single hole for a hanging cord penetrates through the face of the painting in the center of the upper strainer member. A simple half lap joint was identified in a painting of the *Virgin of Mercy* (BM#41.1275.180) by an unknown Peruvian painter; in addition, a decorative single leaf pattern carved molding was attached through the face of the painting into the strainer with wooden pegs, still detected at a few sites on the molding.

A slight modification of the simple half lap joint utilizes a mortise/tenon concept whereby the mortise is open along the width of the strainer and a tenon of varying configuration laps onto the mortise. This half lap joint modification with a half lap joint crossbar not extending to the outer edge of the vertical members was found on *The Martyrdom of San Felipe de Jesus* (BM#44.47.2) (fig. 18) by an unknown Mexican artist (Gariel 1946).

The modified half lap joinery with the crossbar joint extending the entire width of the strainer is noted on two Mexican paintings by unknown artists (fig. 19a) WCCFA #99-117, five-member, 18th century and WCCFA #99-054B, 9-member, 18th century/19th century (estimate). On *El Velo de Santa Veronica* (BM#45.128.37) the crossbar tenon is dovetailed and slides into a mortise open along the entire width of the strainer (fig. 19b).

A further example of a modified half lap joint was found on a late 18th century painting of *St. John Nepomuk, Priest in Confessional* (BM#44.195.22) by an unknown Mexican artist. This painting is on paper and is adhered about 1/2 inch shy on all sides to fabric that then extends to the edge of and is glued to the strainer. The X-radiograph (fig. 20) shows fine 1/16" points of X-ray dense material in regular 1-inch intervals along the inside edge of the strainer at the site of stretch scallops. The nails or thorns were removed once the glue had set and these voids filled with X-ray dense ground and paint covering the fabric and concealing the edge of the paper.

The mortise is open the entire width of the vertical member as a channel onto which a very narrow tenon laps; the joint faces the fabric and its construction is concealed on the reverse from the viewer (fig. 21a). This type of construction was described by Richard D. Buck in 1972 as "single fork mortise"² (Buck 1972). A painting dated 1760 by an unknown Mexican artist (WCCFA#98-039) further documents the half lap, single fork mortise corner joinery construction. In this instance, the joinery is visible. The crucifixion *Untitled* (BM#44.195.23) on paper adhered to canvas by an unknown Mexican artist shows a similar joinery that is concealed from the viewer. Here, a single fork dovetailed mortise is open along the width of the vertical members into which a narrow dovetailed tenon (fig. 21b) is slid.

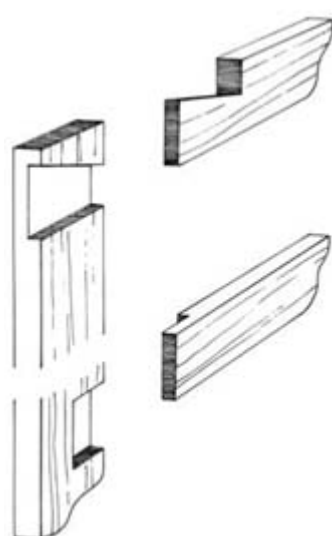


FIGURE 18 Dovetailed half lap joint (6)

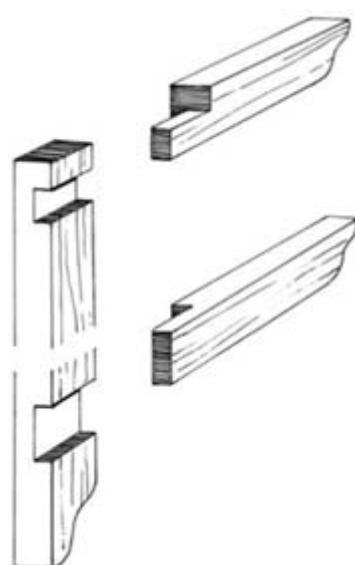


FIGURE 19a Shouldered half lap joint (7)

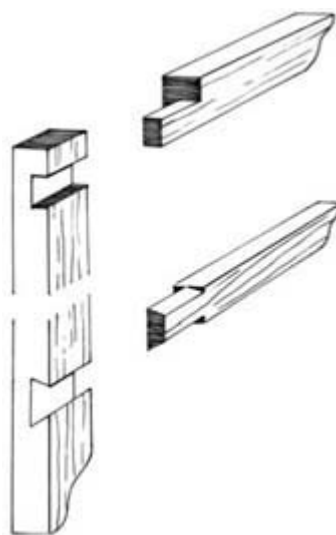


FIGURE 19b Shouldered half lap joint with dovetailed half lap cross-member (8)



FIGURE 20 X-radiograph of *St. John Nepomuk, Priest in Confessional* (BM#44.195.22). Image courtesy of the Brooklyn Museum.

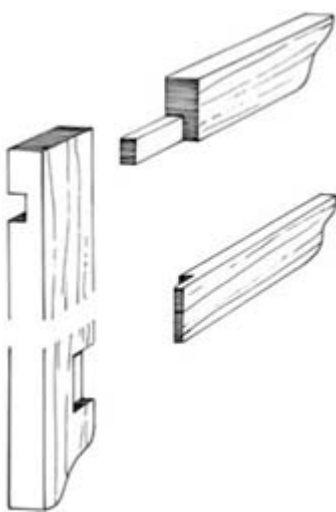


FIGURE 21a Single fork mortise (Reverse shouldered half lap joint) (9)

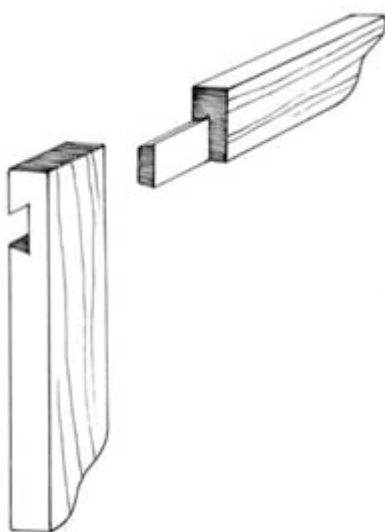


FIGURE 21b Single fork dovetailed mortise (Dovetailed shouldered half lap joint) (10)

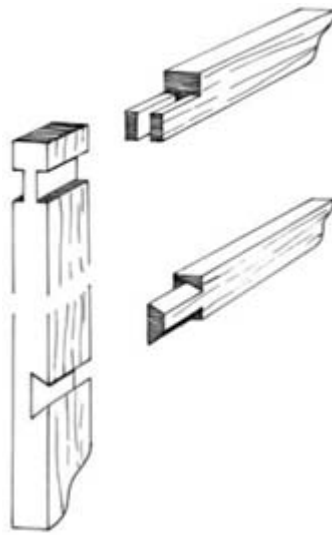


FIGURE 22 Double fork mortise (Shouldered bridle joint with dovetailed cross-member) (11)

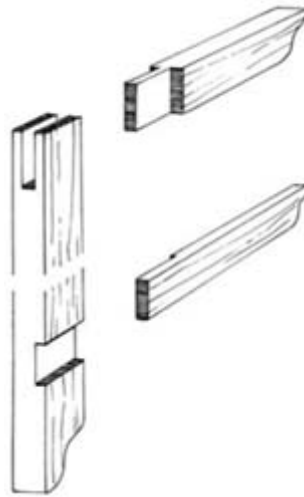


FIGURE 23 Simple mortise (Bridle joint with half lapped cross-member) (13)

The most commonly found joint in this study is the “T” configuration as described on Colonial paintings of the first half of the 18th century (Gariel 1946, 99). These joints are described by R. D. Buck as “double fork mortise”³ (fig. 22). Of the fifteen paintings with a T corner joint, eight showed half lap crossbars with straight edges, while seven showed dovetailed crossbar joints that remained approximately the same width as the crossbar or reduced in width on the back, as in the depiction of *Christ of Chalma, Crucifix with the Virgin of Sorrow and St. John* (BM#45.128.191) (Tomkiewicz 1995).⁴

Although this painting is dated 19th century, it may be earlier according to the strainer construction. Examples of the T construction from the 18th century in the inventory of the Fundacion Tarea include No. H08, JJPM12 and JJSF10, and H32. Four ex-voto paintings (Acc. #86.36.30, #86.36.9, #86.36.40, #86.36.72) from the collection of The University Museum, University of Pennsylvania show this typical T joinery.⁵ The joint described by R. D. Buck in 1972 as “simple mortise”⁶ is defined by Gariel (1946, 101) as occurring at the end of the 18th century and the beginning of the 19th century (fig. 23).

Virgin of Guadalupe (BM#45.128.189), signed Ysidro Escamilla and dated 1824, is a painting of Mexican origin that shows this simple mortise construction (Tomkiewicz 1995, 104). Using this same stretcher construction in the third quarter of the 19th century, the Mexican artist Pelegrin Clavé y Roqué stretched the portrait of *Don Ygnacio Cecilio Algara Gómez de la Casa* (BM#52.166.13) with tacking margins and tacks in the typical Western manner.

This study is not all-inclusive of Spanish Colonial stretcher types. Many of the Colonial paintings in the collection at the Brooklyn Museum are mounted on modern stretchers, having been removed from deteriorated secondary original supports in the 1960s and 1970s; no information exists on the original supports for these paintings. In 1997, the Brooklyn Museum acquired the *Madonna and Child* (BM#1997.193.1) by an unknown Peruvian artist. A custom's declaration of sale pinned to the reverse and dated 1962 claims that the frame with its painting is a reproduction, not older than 120 years (i.e., not older than 1840). The painting has been cut down and the canvas wrapped around the edges of a half lap strainer with its mitered, beveled side against the canvas and butt joint seen on the reverse.

This survey offers information about fabrication methods and aims to contribute to the understanding and ultimately in the preservation of the original material. The condition of these paintings appears dependent upon the history of both their individual utilitarian function and their maintenance. Often serving a religious purpose, many paintings surveyed show evidence of having been embellished with repainting or maintained by virtue of indigenous repairs, including patching and stitching. In general, planar irregularities are common occurrences as are delamination along the edges or throughout between primary and secondary supports. Planar deformation is a likely result of differential response of fabric, wood, and animal adhesives to fluctuating environments. An understanding of the materials alongside an acceptance of inevitable changes will support a conservative approach in preserving these unique works.

Carolyn Tomkiewicz

Submitted February 2007

Conservation and Contemporary Stretchers

Keyed Stretcher Designs

Historical Review

Keyed stretcher designs are a relatively recent development. The development of the auxiliary support (strainer/stretcher frame) system followed the use of canvas as the sole support for paintings. Artists were familiar with fabric as an artist's material because linen was often used as an interlayer between the panel and ground. The earliest documented example of a painting in oil on canvas is Uccello's *St. George and the Dragon* (National Gallery of Art, London) c.1460 (Hedley, Mehra, and Villers 1980, 3). Canvas was a practical alternative to wood, as it was not prone to worm infestations, did not split, and was easy to obtain in a desired size and to transport. In addition, it was less costly (Hedley, Mehra, and Villers 1980, 3). Once artists chose to use a flexible substrate such as linen or cotton as a sole primary support, the development of the auxiliary support soon followed.

Before the 19th century, stretchers were often constructed in a utilitarian remedial fashion out of secondary materials (ICOM 1960, 150). These auxiliary supports were more often than not strainers, having a set level of stress and lacking a system of increasing or decreasing size. The first keyed stretcher designs did not appear until the mid-18th century and in one contemporary text from 1754 are mentioned as a new invention (ICOM 1960, 150). Since that time, many attempts have been made to improve the keyed stretcher. Lacquering of the stretcher members to avoid warpage and beveling to prevent the bars from resting against the canvas verso are just two of these improvements (ICOM 1960, 151). Still, the basic premise of the keyed stretcher—to increase or decrease the amount of stress applied to a canvas—has remained the same. The methods of fabricating this design, however, have evolved over time.

Materials/Fabrication

In 1972, Richard Buck, in *Stretcher Design, a Brief Preliminary Survey*, named six types of auxiliary support designs. Type I auxiliary supports are strainers. This is the least complicated way to stretch a primary support fabric and often allows for some movement within the frame as it responds to movement in the fabric. The designs include the following variations: a) butt and nail (fig. 24a); b) mortise and pin (fig. 24b); c) half lap and pin (fig. 24c); and d) wedge mortise and pin (fig. 24d). The first three variations in the adjustable mortise system have a mortise that is not hidden and its entry into the tenon is visible from the side of the stretcher bar it fits into. For the most part, these strainers appear planar in profile, lacking beveling or a bead to prevent contact of the canvas with the strainer members. The following auxiliary support types are stretchers whose members can be beveled or beaded to isolate the canvas presentation surface edges from the majority of the stretcher bar surface area.

Type II auxiliary supports include five variations of the adjustable mortise. The first three variations in the adjustable mortise system have a mortise that is not hidden and its entry into the tenon is visible from the side of the stretcher bar into which it fits. The first of these is the simple mortise corner with two keys, which permits the extension of the frame in two directions (fig. 25a). The second variation is a simple mortise corner with two interlocking keys, which prohibits the loss of the keys (fig. 25b). This stretcher type is often referred to as an Italian stretcher (Liu 1999). The third variation is a simple mortise corner with a variation in the shape of the mortise and/or keys (figs. 25c, 25d). The fourth variation on Type II auxiliary supports is the blind mortise corner with keys (fig. 25e). True to its name, this system conceals evidence of the mortise once it is fitted into the tenon. The fifth variation also has a hidden mortise with an extended bead and keys (fig. 25f). The extended bead refers to the wooden portion that “carries the edge of the canvas evenly to the corner miter, improving the appearance of the stretch at the corners” (Buck 1972, 1). In profile, these stretchers would be either planar or beveled and the fifth variation illustrates a bead that isolates the majority of the canvas presentation surface edges from the stretcher bar members.

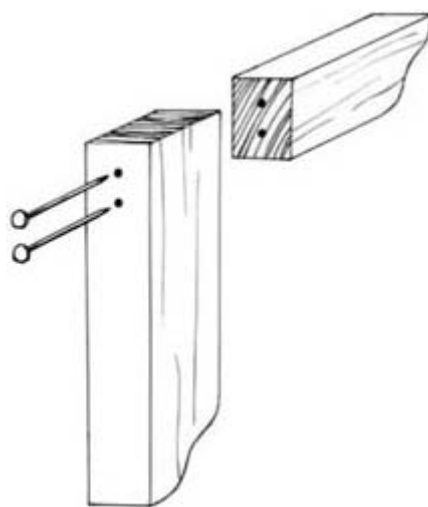


FIGURE 24a Butt and nail (1)

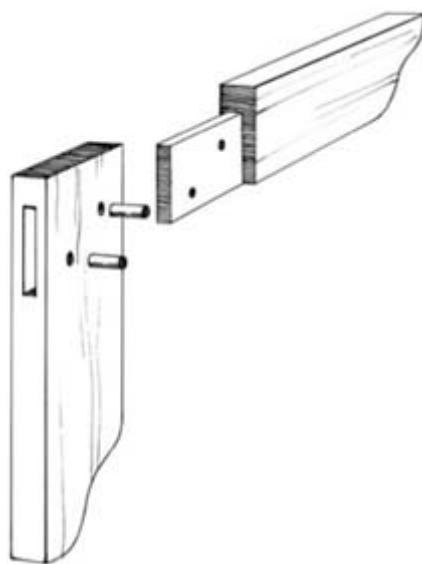


FIGURE 24b Mortise and pin (2)

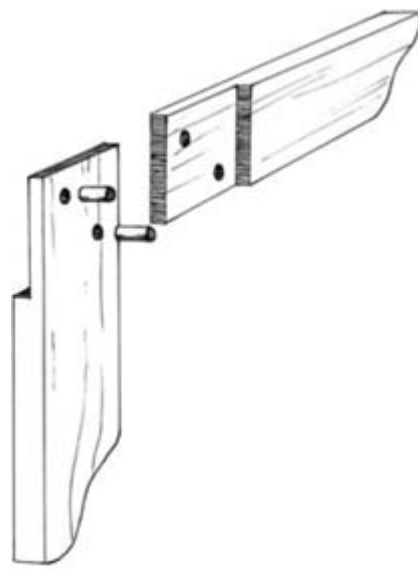


FIGURE 24c Half lap and pin (3)

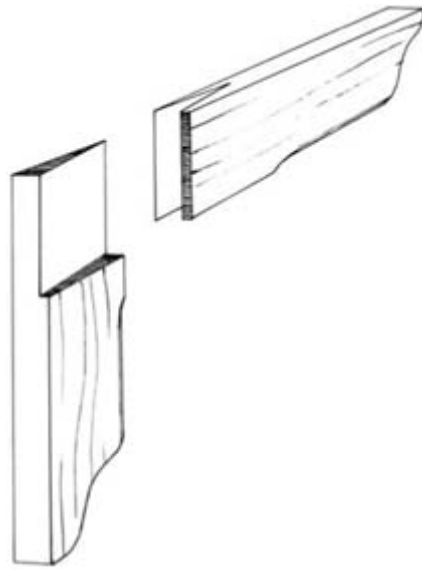


FIGURE 24d Wedge mortise and pin (15)

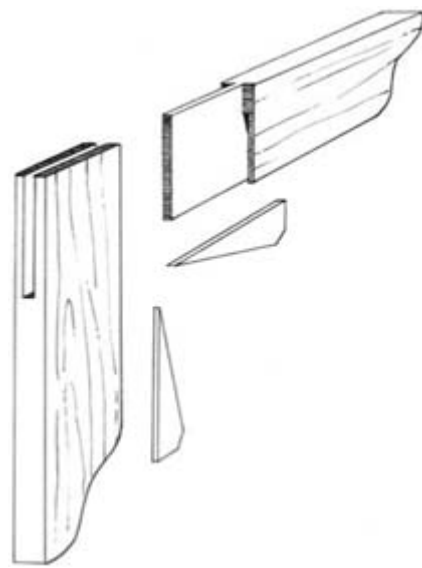


FIGURE 25a Simple mortise with keys (17)

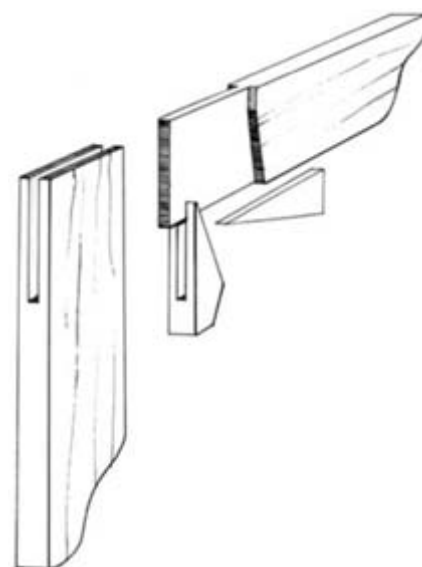


FIGURE 25b Simple mortise with interlocking keys (18)

Type III auxiliary supports include a mortise and a half miter corner with keys (fig. 26). This is often referred to as French construction (Liu 1999). This means that from the reverse, the stretcher appears to have a simple mortise and tenon construction but the other side of the stretcher reveals a miter.

Type IV auxiliary supports include two variations of a mortise corner with a double miter and keys. This form of stretcher corner was often used in the 20th century and its method of construction is used for many commercial stretcher bars in art supply stores (fig. 27a). This stretcher type is often referred to as a traditional American stretcher (Liu 1999). A second variation on this construction is the ogee variation on the double miter (fig. 27b). Instead of the standard miter, the edges of the two stretcher bars are in ogee form and fit together in a “yin yang” style.

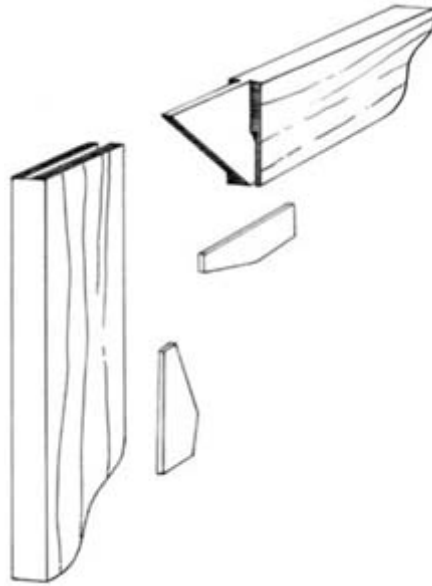


FIGURE 25c Simple mortise modified form with keys (20)

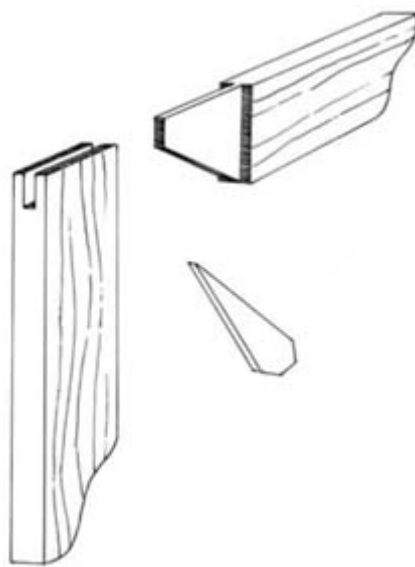


FIGURE 25d Simple mortise modified form (variation) with key (21)

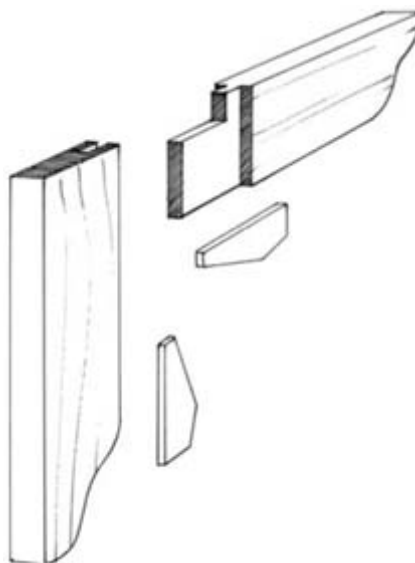


FIGURE 25e Blind mortise with keys (24)

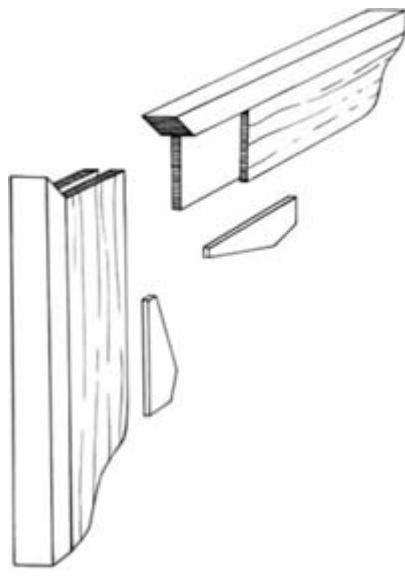


FIGURE 25f Simple mortise and extended bead with keys (22)

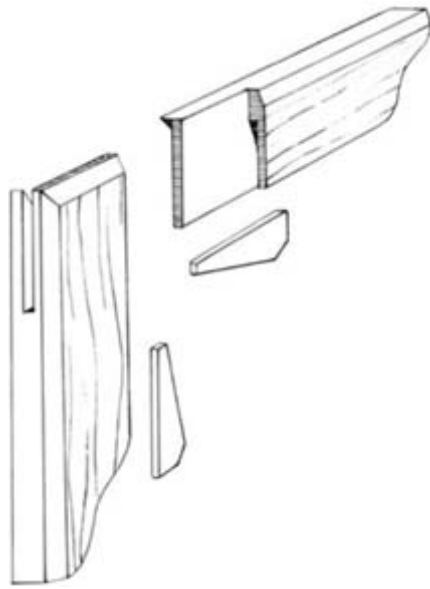


FIGURE 26 Mortise and half miter with keys (33)

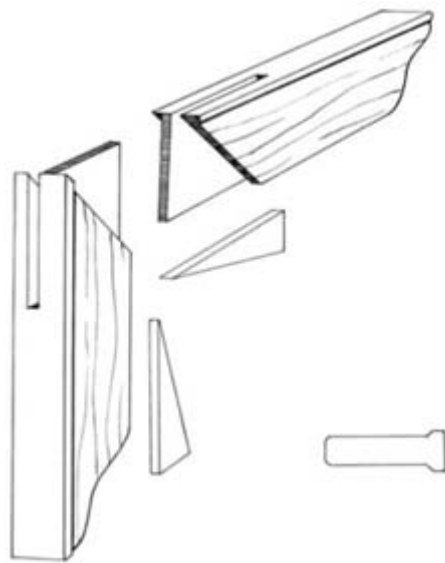


FIGURE 27a Mortise and double miter with keys (36)

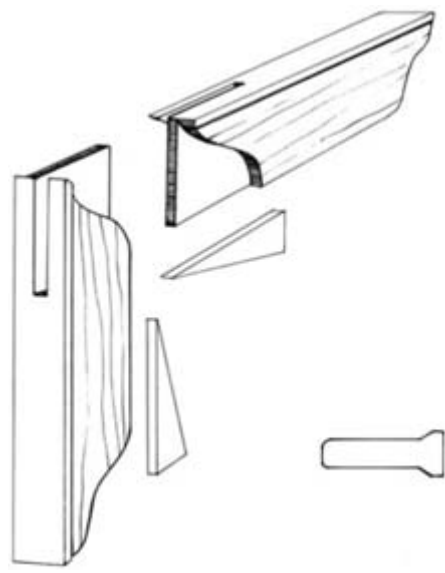


FIGURE 27b Mortise and double miter, ogee variation with keys (37)

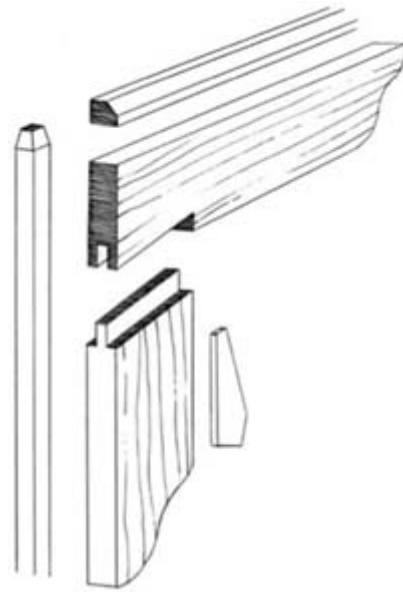


FIGURE 28 Tongue and groove ramped with single key (38)

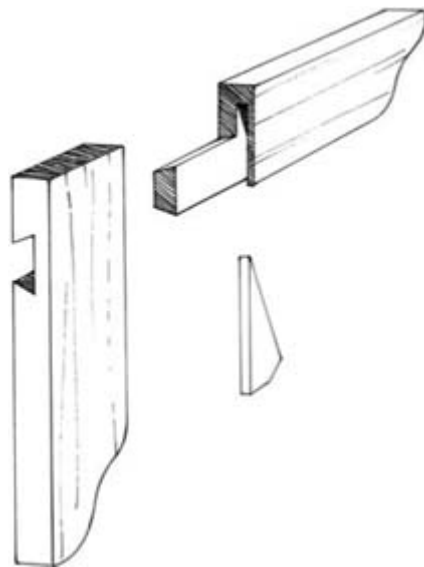


FIGURE 29a Single fork mortise, dovetailed and keyed (39)

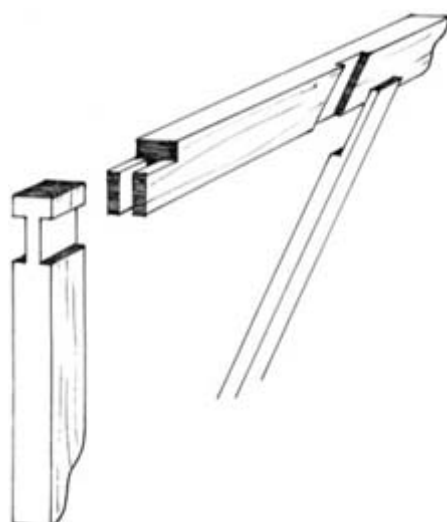


FIGURE 29b Double fork mortise with keyed brace (11)

Type V auxiliary supports have what Buck terms a “tongue and grooved ramp with a single key” (fig. 28). The previously discussed stretcher designs have all allowed for two keys per corner. In this design, a single key fits into a slot that is configured to move the stretcher bars in two directions. This type of stretcher is defined as “key-rotary.” Therefore, only four keys, one for each corner, are required to expand the stretcher.

The final type of auxiliary support, Type VI, has corners constructed out of a fork mortise with a single key. The first of three variations on this design is the single fork mortise, dovetailed, with a single key insert, or “key-rotary” (fig. 29a). One key extends one stretcher bar in one direction and a second key extends another stretcher bar in a perpendicular direction. The second variation is a double fork mortise, not dovetailed, with a keyed brace (fig. 29b). The keyed braces can be used with or without keys and the key construction can also be rotary. The final variation is a double fork mortise, dovetailed, with a key construction that can either be “rotary” or otherwise (fig. 29c).

Conservation Use: Advantages and Disadvantages

Preservation of the Keyed Stretcher Design

An original stretcher is part of the painting “package.” There are numerous considerations for the conservator when examining/treating the painting if a painting remains attached to its original stretcher. An original stretcher may be inscribed by the artist or have a stamp of the manufacturer. In addition, it may compensate for eccentricities, such as an atypical format. Not only are these practical considerations recognized, but also the original construction creates a certain aesthetic that many appreciate. The original construction of a painting is significant and unless a stretcher is unsound and beyond repair, many conservators will choose to preserve this construction.

Mechanics of the Keyed Stretcher Design

As a painting is stretched, many forces act on the canvas to bring the painting into plane. These forces are exerted primarily in the corners but extend into the presentation surface. Although the resulting appearance can be pleasing, continually stretching a painting can be seen as disadvantageous because overstretching may cause future cracking in the paint layer. Often, if a painting appears slack or loose, it will rectify itself when a drop in the humidity occurs, thus causing the canvas to become tauter. When keying out a stretcher, many conservators slip a piece of mat board between the painting and stretcher bars lest the hammer slip and impact the verso of the canvas, causing immediate damage or unseen stress that also may lead to future cracking of the paint layer.

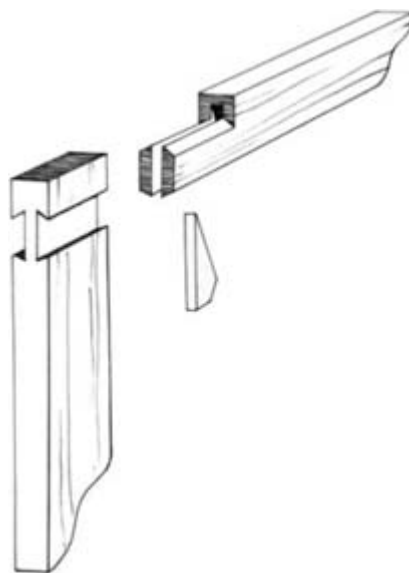


FIGURE 29c Double fork mortise, dovetailed, keyed, often rotary (40)

Advantages and Disadvantages of Keyed Stretcher Designs

Practically, the keyable system allows the conservator to stretch a painting overall or in a localized manner to remedy an isolated deformation, such as a buckle. Keying out a painting with the aid of raking light provides aid in determining to what extent a key may need to be tapped to relieve deformation (Booth 1989, 36). Excessive keying out, however, can weaken the joints of the stretcher and cause tearing of the canvas adjacent to the stretcher joints (Booth 1989, 35). As the painting ages, so does the stretcher, and time can take a toll on the integrity of the wood used to construct a stretcher. Splintering, splitting, and warping are common. Stretcher bar creases in the paint layer are a disadvantage that keyed stretcher designs share with other stretcher and strainer designs. Despite the disadvantages of keyed stretcher designs, many conservators view their unnecessary replacement as a loss.

Keys

Conservators often encounter stretchers with missing, loose, or broken keys. Keys can be lost between the stretcher bars and the canvas causing deformation in the canvas. The use of a hammer to “tap” in and secure a key is often seen as a risky undertaking. The key may break and tapping a key back into place often jars a painting. The loss of keys is sometimes avoided with remedies such as monofilament or silicone adhesive that are used to secure keys. Conservators have also secured keys by dipping them in wax, wiring them to the stretcher, using hot glue and ground glass, or using tape (Stoner 1996, 4) (see section 11 in *Stretchers and Strainers: Treatment Variations*). Finally, some conservators prefer to replace a keyable stretcher system with an expandable system that avoids the “key” element, such as an expansion bolt system (see section 2.2), spring tension design system (see section 2.3), or an overall bar adjustment stretcher design (see section 2.4).

Artist/Contemporary Use

Artists still use keyable stretchers widely, and stretcher bars of varying lengths and sizes are readily available in art supply stores. Buck's Type IV auxiliary supports include a mortise with a double miter and keys. This design, with the exception of the “U”-shaped keys, was patented by Frank P. Pfleger of Joliet, Illinois, on February 2, 1886. The Pfleger-type stretcher has been in American art supply stores for many years and has been used widely by 20th-century American artists (Buck 1972, 16).

As was mentioned earlier, many conservators are hesitant to replace an original stretcher; however, if a conservator deems that a stretcher needs to be replaced, it can be replaced with a variety of stretcher designs. As the format of a painting is often unique, the replacement of an original keyable stretcher with another keyable design requires a craftsperson to tailor a stretcher to the size of the painting.

Erica E. James

Submitted December 2000

Editor's note: Figure captions use the 1972 Buck terminology but are keyed to the illustrations in section 1.1 for variant terminology.

Expansion Bolt Stretchers

Historical Review

The expansion bolt stretcher was invented by James J. Lebron in 1957 or 1958 (Lebron 1999). He refers to it as his “accidental invention.” Mr. Lebron was working in the art department of the Santini Brothers warehouse, in Manhattan. Santini Brothers was a moving and storage company that had been engaged by the Museum of Modern Art (MoMA) to do packing for their circulating exhibits. Caroline Keck, conservator at MoMA, complained to Mr. Lebron about canvas paintings being damaged by fallen stretcher keys. Mr. Lebron's previous experience as a cabinetmaker had made him familiar with a turnbuckle bolting device that was used for putting furniture together. He realized that by using the device at the miters of a stretcher's corners and at the cross-members, it would hold the stretcher together and allow it to be expanded. Mr. Lebron showed the bolts to Mrs. Keck and explained his idea. Mrs. Keck asked him to make up some sample stretchers. She then gave a party at her home, where the stretcher was introduced to the New York conservation community. Jean Volkmer, Margaret Watherston, and Bernard Rabin were among the guests. The invention was instantly accepted. Mr. Lebron began to get orders for stretcher construction almost immediately. The stretcher construction business grew until he no longer had time to work for Santini Brothers.

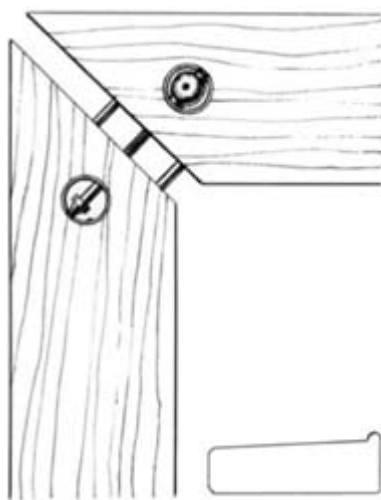


FIGURE 30 Expansion bolt stretcher

Materials/Fabrication

The design of the stretcher has been consistent since the beginning (fig. 30). The stretcher bar must be a minimum of 1 1/8" thick and 3 1/4" wide. Initially the stretchers were constructed of bass wood, but the use of sugar pine was adopted because it was available in longer, straighter lengths. Corners and stretcher bars are held together, and held apart, by the expansion bolts. The profile of the molding was designed to reduce the formation of stretcher bar creases. A 1/4" x 1/4" bead may be cut at the outer edge of the molding with the interior beveled down at a 2 degree angle. Often the stretcher is manufactured without the bead and just has a bevel all the way to the outside edge. The inner edge of the beveled section is slightly rounded. Mr. Lebron has not established any specific formula for the addition of cross-members. He works with the conservator or artist to adapt the stock size of the wood, or number of cross-members, to the specific painting. Smaller stretchers can be delivered assembled; larger stretchers are delivered broken down and can easily be reassembled by the user.

Conservation Use

The advantages of the stretcher were obvious from the beginning. The need for keys is eliminated. This is an expandable stretcher that has the structural integrity of a strainer. Hanging devices can be attached directly to the stretcher, and stress is not transferred to the canvas. The canvas is no longer holding the stretcher together, as it does on a traditional, keyable stretcher. This stretcher prevents the formation of corner draws that can develop when hanging devices are attached to a keyable stretcher. The stretcher is also easy to assemble and disassemble (see below, “Assembling an Expansion Bolt Stretcher”).

However, there are disadvantages. Because of the size of the expansion bolts, there are limitations on how small or how thin a stretcher can be constructed. Very small stretchers or stretchers thinner than 1 1/8" cannot be made. Corners cannot be expanded in just one direction; they expand in both directions at the same time. Moreover, the small metal rod used for expanding the turnbuckle is not a commonplace item in an average toolkit. Of course, this may also be considered an advantage in that it discourages an overzealous owner from over-expanding the painting and causing damage.

Artist/Contemporary Use

According to Mr. Lebron, expansion bolt stretchers became fairly popular with artists, such as Morris Louis. Since hanging hardware can be attached directly to the expansion bolt stretchers, they are ideal for large modern paintings where a frame is not desirable. Its ease of disassembly and reassembly make it useful for large paintings that are commonly removed from their stretchers and rolled for shipping. Cost concerns limit its appeal to some contemporary artists. Many artists are simply unaware of its existence and its advantages.

Assembling an Expansion Bolt Stretcher

A new expansion bolt stretcher may arrive disassembled for shipping purposes. Reassembly is a relatively simple matter. Lay the members of the stretcher out on a horizontal surface. Arrange them in the correct configuration by matching up the numbers or lines that have been penciled at each joint by the manufacturer. Joints should always be marked on a stretcher before it is disassembled; remember this if you need to disassemble a stretcher. If your manufacturer has neglected to mark the joints, careful test fitting and visual inspection of each joint will be necessary to determine the correct placement of each member. Top and bottom members, and left and right members, are not necessarily interchangeable.

Once the members are laid out in the correct configuration, if there are horizontal and vertical cross-members, screw them together using the holes drilled at their overlap and with the screws provided. There should be a turnbuckle and two metal pins at each joint. Place the protruding ends of each turnbuckle into the hole drilled in the opposing stretcher member. Lightly push the members together so that each metal pin slightly enters a hole in the opposing stretcher member. Once all the joints are lightly pushed together, tap each joint into place (a rubber mallet is a good tool to use for this procedure) a little at a time, taking care not to mar the wood, until the stretcher is completely assembled.

Extend or retract a turnbuckle until the arrowhead-like tip is visible in the large hole cut in the back of the stretcher member. Position the tip of the arrowhead so that the flat portion is perpendicular to the picture plane. Place the C-ring over the arrowhead; the notch is placed just behind the arrowhead and the open part of the C is placed over the flat part of the arrowhead. Slip the C-ring down into the hole and over the arrowhead; you may need to hammer it in. The C-ring should fit snugly into the hole in the back of the stretcher member. There may be a small nail hole drilled into

the C-ring. A small brad may be inserted in this hole to keep the C-ring from falling out, although if the stretcher is slightly expanded after canvas stretching, the C-ring will be held in place by the arrowhead. If necessary, the stretcher may be contracted with the turnbuckles to square it up and keep it properly assembled until it is needed.

Steven B. Erisoty

Submitted October 2006

Spring Tension Stretchers

Historical Review

The concept of incorporating springs into the corners of stretchers to maintain more constant tension was apparently first included in a U.S. patent by J. E. Todd on September 18, 1866 (Katlan 1992, 71–72). The expressed desire was to make the stretcher self-adjusting, “avoiding the use of keys or wedges” and ensuring that “the canvas will, by the yielding or expansion of the springs, be always tightly drawn.” The concept was used again in patents by J. D. Crocker in 1870 (Katlan 1992, 79–80), Crocker and Brand in 1871 (Katlan 1992, 83–84), and Wright and Gardner in 1875 (Katlan 1992, 93–94). All of these historical examples were similar in having springs embedded in the stretcher bars, so that their tension was not adjustable. In all but one case (Crocker and Brand's version), tension at each corner was provided by a single spring set at a 45-degree angle across the corner. In my experience, these early spring stretchers were not widely used; I have encountered only one in almost thirty years of practice.

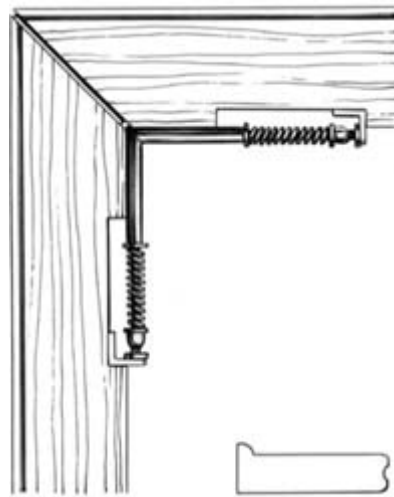


FIGURE 31 ICA Spring Stretcher corner mechanism

In 1950, Richard Buck introduced the ICA Spring Stretcher, a design that continued to be manufactured from the mid-1990s until 2002 under the name Superior Spring-Stretcher. It is primarily used as a conservation (replacement) stretcher, although it is available for purchase by artists. As a student of stretcher design history, Buck sought to remedy what he saw as problems in the performance of other stretcher types, especially fluctuations in canvas tautness caused by environmental factors. In his words, the stretcher is “designed to be the dynamic partner of a fabric under stress” (ICA Spring Stretcher literature).

Materials/Fabrication

The ICA/Superior Spring-Stretcher consists of straight-grain redwood primary members (in 2002, redwood was no longer available in Illinois for nature conservation reasons, and Honduras mahogany was substituted), joined by aluminum hardware (fig. 31). The stretcher members are coated with a polyurethane varnish. Stretcher members are beaded and beveled and are provided in two sizes depending on the length of sides required. Each stretcher is made to order and can be obtained in very precise dimensions. Corners are stabilized by square aluminum splines that fit into grooves in each member; expansion is controlled by springs on each side of the corner that drive an angled brace tube against the opposing member. The springs are compressed, after the canvas is mounted, by finger-tightening a nut along the rod that carries the spring. Cross-members, if used, are aluminum tubes in one direction and redwood bars in the second (allowing the tube to pass through the wood cross member at the intersection), and they are expanded by similar mechanisms (fig. 32). All springs are of similar stiffness, said to exert a force of about 12 pounds for each 1/16-inch compression, with a recommended compression of 3/32 of an inch per spring for a canvas of 25 x 30 inches (ICA Spring Stretcher literature). An advantage of this design over earlier spring corners is that each spring is individually adjusted, so that canvas weight, weave type, and variation in side lengths can be taken into consideration.

Stretchers are delivered broken down, to be assembled by the user. Interchangeable hardware packets accompany the bundled stretcher members, and an instruction sheet, with photographs, illustrates proper assembly. To the best of my knowledge, the stretchers are not currently being produced for sale.

Conservation Use: Advantages and Disadvantages

Few designs have attracted as much continuing controversy in our field as Buck's stretcher. In use by conservators now for nearly fifty years, they remain an anathema to many. Arguments against them range from aesthetic distaste to stress concerns; proponents like the way they work. As with any technique or tool, they can inflict damage if misused, but attention to Buck's original instructions for mounting the painting, adjusting tension, and setting in the frame will prevent the most egregious errors.

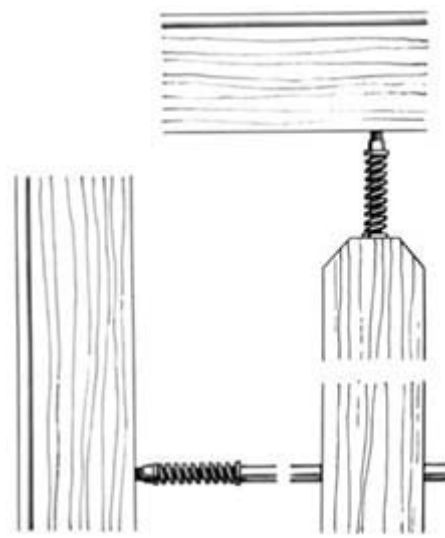


FIGURE 32 ICA Spring Stretcher cross-member mechanism

The most compelling argument in favor of this design is its ability to maintain even tension in the face of changing environmental conditions. In a situation where climate cannot be perfectly controlled, these stretchers do what stretchers were invented to do: they keep paintings in plane. By adjusting springs to the compression required in each individual case, a minimal effective tension can be set and held. Other advantages are that these stretchers are strong, lightweight, and resist warping, twisting, and insect infestation.

The spring stretcher's radical difference from any stretcher it might replace is the basis for most arguments against it (information derived from conversations with many colleagues and clients over twenty years). First, it looks different; dealers, curators, and owners can all be put off by its nuts-and-bolts appearance. Many conservators prefer to use a more traditional looking stretcher simply for the aesthetics. Second and probably more significant, arguments against the spring design center on the stress it places on the painting. While more traditional stretcher designs can make a painting initially drum-tight but will not hold that tension over time, a spring stretcher, if improperly adjusted, will constantly expand a canvas, contributing to new crack patterns in the paint layers and even to rips at corners. Of course, any replacement stretcher will alter the original stress patterns in a structure and can be over-expanded. It might be argued that spring stretchers are less likely to be readjusted by inexperienced handlers than more traditional designs.

Artist/Contemporary Use

According to Barry Bauman, formerly of Chicago Conservation Center, who used to manufacture the Superior Spring-Stretcher, very few artists have employed this design as original equipment, although he was perfectly willing to sell the stretcher to them. Cost concerns and the lack of general marketing of the design restricted it primarily to conservation use.

Special Considerations: Application and Adjustment

When Richard Buck introduced the spring stretcher for conservation, he addressed other perceived imperfections in traditional stretching methods as well. To prevent the uneven tension of a fabric attached only by tacks or staples, he advised sealing the edges of the painting to the stretcher continuously with a reversible lining adhesive; to reinforce corners, he recommended tabs of fabric be carried around the corner and secured with adhesive and tacks. Using his method, the painting is mounted to the stretcher facedown, its alignment having been previously established, and the edges are drawn up and sealed so that it is evenly taut. Adjustment of the spring mechanism completes the stretching and, as a last step, the springs are backed off slightly to prevent over-expansion. The importance of not restricting the movement of the stretcher—by framing hardware, frame opening size, or improperly attached backings—is obvious.

Buck wrote of his design, “Under such gentle forces even an aged and brittle fabric can endure for years without tearing at the stretcher edges, and it is spared the seasonal variations in tension that are imposed by a fixed stretcher” (ICA Spring Stretcher literature). In today's practice, however, it is unlikely that any conservator would consider replacing an original stretcher on a painting showing any degree of deterioration in the fabric support with a spring unit without also providing additional support for the fabric, at least in the form of a strip lining or loose lining.

As a conservator who used these stretchers for over twenty-five years, since they were introduced to me by a Buck student who was my post-program supervisor, I have been alert to arguments for and particularly against their use. There is no question that they provide a different and more constant tension than other designs. I have never seen a painting belly, draw, or cockle on one of these stretchers nor have I seen corners tear as some naysayers predict. Even so, I am aware that I am changing the original nature of a painting when I apply one and that I may well be introducing forces that could eventually cause a new type of deterioration.

I believe, however, that this is true of any change a conservator makes, even the removal and replacement of an original stretcher. If a painting came to me needing additional support, and especially when it was returning to an unstable climate, a spring stretcher was frequently part of my prescription for its future. For each such decision, the individual conservator bears responsibility.

Author's note: The Buck design was manufactured on a very limited basis by Superior Spring-Stretchers, a division of The Chicago Conservation Center, 730 North Franklin, Suite 701, Chicago, IL 60610 (phone 312-944-5401; fax 312-944-5479). Although the Chicago Conservation Center may continue to manufacture these stretchers for their own conservation use, they are no longer commercially available.

Dee Minault

Submitted November 2006

Please see the Addendum to this chapter, Cadmium-Containing Corrosion Products on ICA Stretcher Bars - Identification and Abatement, for additional information.

Continuous Tension Stretchers

Starofix Stretchers

Historical Review

A self-adjusting or automatic stretcher with continuous tension is one that allows fabrics or other stretchable materials to expand and contract, automatically thereby adapting to their variations in tension. This can only be achieved by fitting a frame with variously arranged expansion mechanisms that are composed of tighteners and springs to regulate tension. Ideally, stretchers with continuous tension should encompass all of the following qualities and functions. They should:

- Provide a support for fabric paintings that is constantly planar, non-sagging, and free of other unwanted distortions;

- Preclude or at least minimize the historic problem of stress concentration at the corners and provide evenness of tension throughout the stretched materials (the goal being to eliminate buckling and other distortions in the fabric and consequently cracking and other damages in the paint layers);
- Provide safe and balanced stress distribution within the different materials comprising the painting;
- Minimize the need of periodically readjusting the tautness of paintings (as is often required with conventional stretchers); and
- Supply a system that is reliable, simple, and possibly adaptable and/or reusable.

In the following description of the different stretchers, I will try to determine if and to what extent each serves the above-mentioned objectives. I shall present each device following a chronological sequence.

The simplest and possibly oldest auxiliary support design consists of four bars of wood, very simply connected to each other at the corners (strainer). Traditional stretcher design has remained virtually unchanged for centuries. It comprises four wooden members that can be expanded by the application of force at the joints, usually by hammering keys or wedges into slots in the inner corners to make the fabric taut.

We all know the limitations of these two types of stretching systems. These limitations must have also concerned some of our predecessors because as early as 1866, J. E. Todd was awarded a U.S. patent for a stretcher that included a spring mechanism (Katlan 1992). In 1875, J. P. Wright and D. W. Gardner were also awarded a patent for a stretcher with similar features. The simply mitered wood members are kept together at each corner by two dowels inserted diagonally, with a helical spring enclosed between them. The tension generated by the spring is not adjustable and expands the whole corner at once.

A German patent dated 1900 claimed the first invention of an “automatic stretcher for paintings.” A fitted spring mechanism shaped like a crossbow expands each corner out-ward and can be adjusted by means of a nut assembled with a screw inserted at the miter and held in place by a plate. In this case, the tension can be adjusted but, again, each corner expands as a whole (fig. 33).

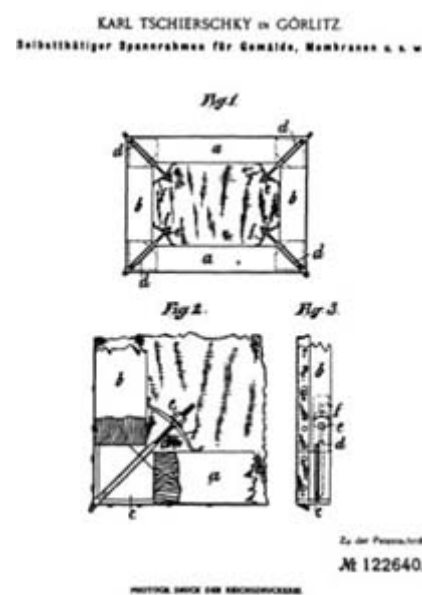


FIGURE 33 German patent dated 1900 with spring mechanism

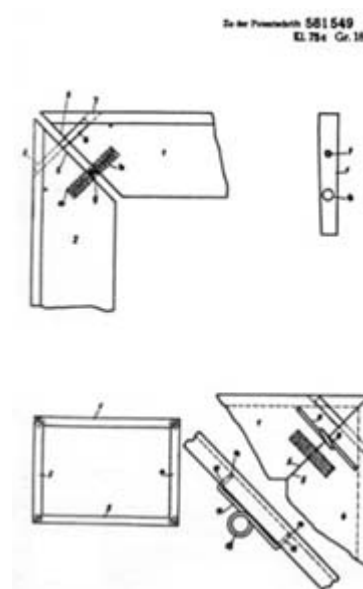


FIGURE 34 German patent dated 1932 similar to 1875 Wright and Gardner patent with additional temporary retaining mechanism used during stretching

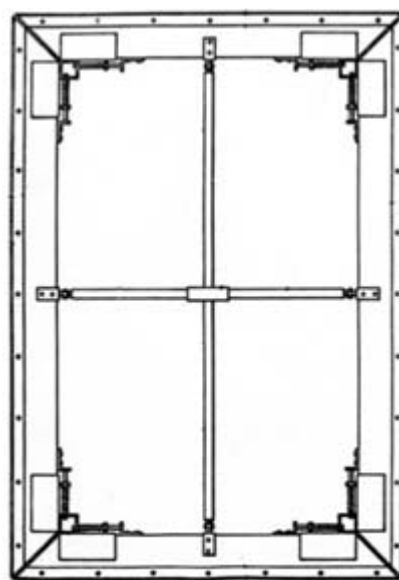


FIGURE 35a 1980 French patent slightly varied from Buck's design for the ICA Spring Tension Stretcher

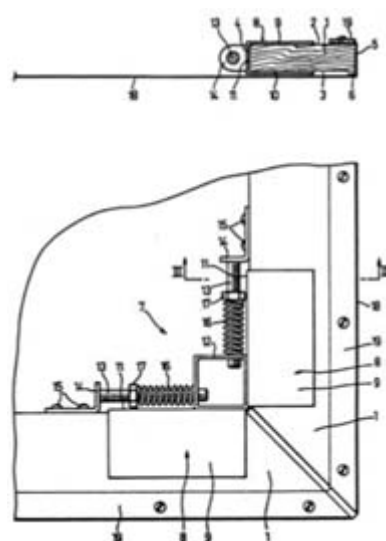


FIGURE 35b Detail of 1980 French patent corner spring tension mechanism

Another German patent dated 1932 presents a substantially similar version of the U.S. invention of 1875, with the addition of a retaining mechanism that is temporarily introduced into holes at the miter and keeps the spring tight during the stretching of a fabric. When the spring is released, a certain expansion of the bars is generated. Here, too, the spring cannot be adjusted and the whole corner is simultaneously expanded (fig. 34).

In 1950, Richard Buck designed the “ICA spring stretcher,” the first constant tension stretcher allowing for the expansion of corners in both directions (see section 2.3). Eight built-in spring mechanisms controlled by the adjustment of screws generate the outward expansion of each opposite wooden member. The simply mitred corners have an inserted spline to allow for the lengthwise motion of the members while keeping them assembled and preventing them from twisting. When necessary, crossbars also fitted with springs can be added to the construction. The stretcher is commercially available in the United States. (In 1980, a French patent slightly varied Buck's design with a more complicated joining system, necessary to keep the simply mitred members assembled. It is unclear whether this stretcher has ever been manufactured) (figs. 35a, 35b).

In 1966, Franco Rigamonti designed and produced the first aluminum stretcher with automatic tension for the purpose of stretching the two large Caravaggio paintings, which had been conserved and lined at the Istituto Centrale del Restauro, for the San Luigi dei Francesi church in Rome (Urbani 1966, 65-76). The main frame is composed of extruded aluminum channels, sturdy and complex in design, that are mitred. The members are held together by fabricated solid aluminum joints to be inserted into the central hollow section of the channels. The joints have screws and helical springs mounted at each end, which can be tightened through a slot on the back of the frame. By tightening the screw, the joint insert pushes the opposite member outward, generating constant tension. The canvas is attached by means of specially fabricated metallic canvas holders with teeth, which are inserted from the reverse into an *ad hoc* channel. In the 1970s, I used several of these stretchers for large church paintings, with excellent results. The only drawback was that special canvas holders were cumbersome to insert and once bent, were difficult to reshape for reuse (figs. 36a, 36b).

Since the mid 1970s, several studies relating to the mechanical behavior of canvas paintings have been published and have helped in better understanding problems associated with stretching (Berger 1981, Berger and Russell 1990, Hedley 1975, Mecklenburg 1982, Russell and Berger 1982). The negative influence of overstretching in the corner zone is cited as a source of buckling and cracking. To overcome such influences, Berger in particular insisted on the importance of combining controlled, continuous stretching with unimpeded movements of the canvas mainly in regard to its side edges. More recently, Del Zotto proposed similar solutions advocating free movement along all the stretched edges (Del Zotto 1990).



FIGURE 36a 1966 Rigamonti design for aluminum stretcher with self-adjusting continuous tension

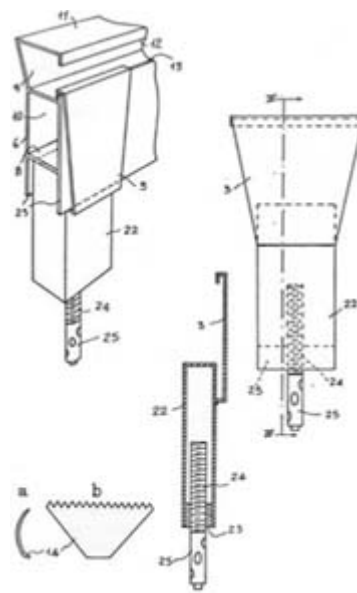


FIGURE 36b Detail of Rigamonti aluminum stretcher with self-adjusting continuous tension mechanism and canvas holders

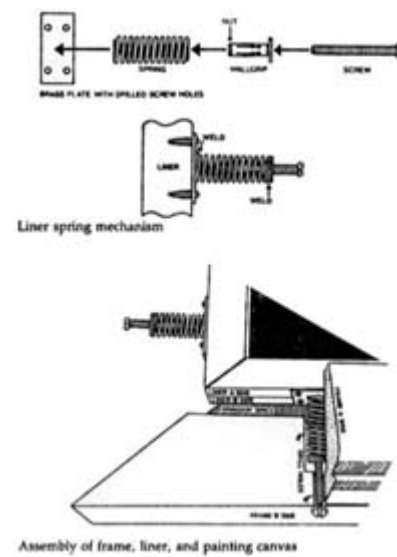


FIGURE 37 1982 Bauman modification of spring tension stretcher for double-sided painting

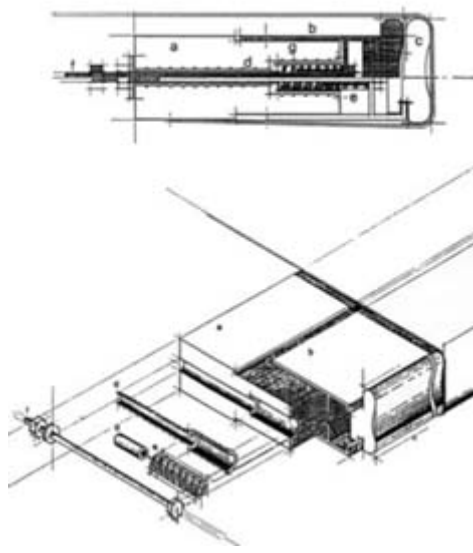


FIGURE 38 1990 Del Zotto stretcher design with self-adjusting continuous tension

In 1982, Barry Bauman designed and fabricated an interesting device for stretching and framing a double-sided painting that incorporated an adjustable spring mechanism to ensure continuous canvas tension. The inner frame (the liner) holding the canvas edges is pulled by screws with springs coiled around them toward an outer frame that retains the whole construction (Bauman 1982) (fig. 37).

In 1982, Giorgio Staro was granted a Swiss patent for the Starofix stretcher, a new type of aluminum stretcher to give adjustable, automatic tension to paintings. A thorough description of this stretcher follows in the section below titled “Materials/Fabrication.”

Since the early 1980s, Gustav Berger, in collaboration with William Russell, studied the behavior pattern of stretched canvases in response to environmental changes using electronic equipment to monitor and record the results. In 1984, Berger published these results in a study treating the defects of conventional stretchers with keys and, in particular, the related distortions at the corners and the “bellying” of canvases. To overcome these defects, he proposed a self-adjusting stretcher with continuous tension having a main rigid frame. The horizontal movable top member is provided with springs, while movements along the vertical bars are unrestrained (no nails). The margins of the canvas, however, are retained by sleeves with the addition of a limited number of springs with turnbuckles for tensioning. The free movement of the canvas is facilitated by the addition of Teflon® tape covering the vertical edges of the main rigid frame (Berger 1984).

In 1990, Franco Del Zotto published a study presenting another stretching device with self-adjusting continuous tension that allows unimpeded movement of the canvas along all the stretching edges. The main rigid wooden frame has an H-shaped movable aluminum bar with an inserted low-friction sliding profile and fitted mechanisms contained within the wooden frame, complete with screws and springs to exert a desired tension. The canvas slides on the outer wooden edge, creating a more even distribution of tension forces (Del Zotto 1990) (fig. 38).

Materials/Fabrication

In 1982, the Starofix stretcher was first introduced in Switzerland, and in 1984 in the United States, through the company Starofix North America. The Starofix stretcher is a new design of aluminum stretcher capable of giving adjustable automatic tension to fabrics (fig. 39a). The main frame is composed of extruded and anodized aluminum H-shaped channels that are precisely mitered. Specially cast aluminum corner pieces (joints), inserted into the central hollow section of the channels, hold the frame together.

Eight tensioning mechanisms are inserted into the interior recess of the frame. Each mechanism comprises an aluminum block with a screw on one end and a single-loop spring on the other end. The screws are tightened with a special hexagonal wrench or by hand. As the screw tightens, the spring, which is inserted into the section through a drilled hole, is put in tension, causing the inserted corner piece to independently expand the opposite section of the frame (fig. 39b). The outer section of the frame retains an inserted beveled wood molding onto which the canvas is stapled. The upper and lower channels of the frame have been designed to be positive/negative, thus sections of the frame can be interconnected for added support in case of very large stretchers (fig. 39c). The same concept applies for the construction of crossbars and hanging devices. Owing to the sturdiness of the frame, crossbars are typically necessary only to support sizes in excess of 72 inches.

The adjustment of the screws and consequently that of the springs is micrometric, and their force can be individually regulated to accommodate the variations in tautness that the stretched material may require (regardless of the forces exerted by the other spring mechanisms). It is difficult to envision another stretcher with continuous tension containing fewer components than the Starofix stretcher.

The stretcher members are delivered disassembled along with the four corner-pieces and the eight tensioning mechanisms, which are ready for insertion. The hexagonal “L” wrench is outfitted with a rubber sleeve so that it can be stored in the inner groove of the aluminum frame. An illustrated instruction sheet is also supplied.



FIGURE 39a Starofix self-adjusting continuous tension aluminum stretcher

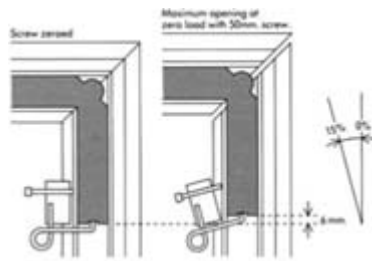


FIGURE 39b Starofix tensioning mechanism

Starofix tensioning mechanism is comprised of aluminum block with screw on one end and single-loop spring on the other end. The spring is put in tension as the screw is tightened thereby causing the inserted corner piece to independently expand the opposite section of the frame.



FIGURE 39c Sections of Starofix frame channels can be interconnected for additional support for large stretchers

Conservation Use: Advantages and Disadvantages

The main advantage of the Starofix stretcher is that it permits precise and independent adjustment of tension in all directions, so that regardless of differences in the stretched material's weave or length, a controlled evenness can be obtained. Another advantage of the Starofix stretcher is that its members are free to slide laterally along the inserted corner pieces. Precisely because the corner pieces require clearance to be inserted, there is a minimal yet necessary looseness which at times can bring a corner out of square. This shift can be resolved by temporarily securing the corners before stretching with wood or paper-board braces held in place with screws or staples.

There is sufficient evidence to suggest that stretchers with continuous tension are, in principle, superior to conventional stretchers and that stretchers made of aluminum are structurally more stable than wooden ones. However, some of the criticism raised toward the Starofix stretcher relates to the use of aluminum and its presumed release of chemical agents that could adversely affect a painting. I have yet to observe any such effect.

If continuous tension stretchers are so preferable, why do relatively few paintings have them as partners? Their limited use could be attributed to several factors, some of which may include their limited availability, relative obscurity, higher cost, unusual and mechanical appearance, or apparent complexity. It could also be that conservators are notoriously cautious and thus prefer to use more familiar materials.

It is generally agreed that conservators should preserve an original stretcher, whenever possible (see section 1 in *Stretchers and Strainers: Factors to Consider*). However, when specific damages to a painting can be attributed to a failing stretcher, my choice for a replacement stretcher would be one with continuous tension. The well-being of the painted surface and the underlying materials should have priority over the maintenance of an original stretcher, especially since the original could be preserved for future reference or for reuse.

I personally have collaborated with the inventor in developing, fabricating, and ultimately distributing the Starofix stretcher in the United States. I have built hundreds of stretchers (including recently one measuring 8' x 28')¹ and stretched many paintings, new and old, with great success. Cracking problems on paintings that have been treated and then restretched on Starofix stretchers have been successfully stabilized; that is, the new planarity achieved prevents the cracks from expanding and diminishes their visual appearance. My own paintings, some dating from 1986, have been painted directly on canvas stretched on Starofix stretchers and still show evenness of tension throughout the surface, excellent planarity, and a total absence of cracks. A published study by Alain Roche examining the role of stretchers in the hygrometric aging of paintings and the related density of developed cracks confirmed the efficacy of the Starofix stretcher (Roche 1993).

Contemporary/Artist Use

When I first introduced the Starofix stretcher, I anticipated a large demand from established artists eager to use such an innovative art material with a distinct contemporary look. To my surprise, it turned out to be quite difficult to convince most artists to change their established routines. Their lack of interest in the stretcher may be due to the fact that stretchers, as a nonvisible component of a painting, receive little attention. Furthermore, artists in general seem to show limited concern with matters related to the aging of their work. Surprisingly, younger or less established artists have often used the stretcher. Among them are Tomie Arai, Martin Disler, Andrew Ehrenworth, Walton Ford, Richard Milani, Olivier Mosset, Joe Overstreet, Alan Uglow, and Jessica Weiss.

Special Considerations

Frequently encountered defects in stretched paintings include uneven stretching and overstretching, usually occurring in the corner zone. It is unlikely that continuous tension stretchers will overstretch a canvas unless excessive expansion is deliberately sought. In fact, overstretching is more likely to occur with conventional stretchers because when a canvas has become distended as a result of ever-changing environmental conditions, it is usually keyed out to obtain renewed tautness. In doing so, the materials comprising the paintings are put under further stress. Eventually, the canvas will distend again and will need further keying out, producing more stress and thus elongation of the fabric.

Special attention must be given when framing paintings that have continuous tension stretchers; the stretcher must be allowed enough room for expansion and must never be attached as to hinder its lateral movement. Protective backing should also be attached in a manner that allows for the expansion of the stretcher. If these precautions are not taken, all the advantages and properties of the stretchers are lost.

In conclusion, I would like to suggest that the well-being of paintings and their visual appearance should have priority over the originality of the stretcher used. After all, the stretcher is merely a tool, a supporting element for the work of art. Inventors and technicians supply new and improved materials to artists and conservators, collectors and curators—ultimately, the decision if, when, and how to use those materials rests with them. Time will tell which materials have best contributed in withstanding the many vagaries to which all paintings are constantly subjected.

Luca Bonetti

Submitted December 1999

Overall Bar Adjustment Stretcher Designs



FIGURE 40 Continuous Tension (CT) Stretcher: detail of upper left. Photograph courtesy of Mira Berger.

Historical Review

Gustav Berger was inspired to develop the Self-adjusting Continuous Tension (CT) Stretcher by his study of cyclorama and panorama paintings. He noted that a unique feature of these large paintings is that they are affixed only along their top edge, allowing the rest of the painting to hang unrestricted. Tension is exerted only by the gravitational pull of the weight of the fabric and paint layers and, as such, remains relatively constant (except for slight variations due to increases or decreases in moisture retention). While the amount of tension overall remains constant, the distribution of tension varies across the surface of the fabric. The tension is greatest at the top of the fabric, where the most weight is exerting gravitational pull on the fabric, and decreases toward the bottom of the canvas, where the least weight is exerting gravitational pull on the canvas. The horizontal stress in the fabric is also greatest at the top, decreasing to zero at the waist of the fabric. In his study of eighteen surviving cycloramas and panoramas throughout the world, Berger observed that the pattern of cracking present in the paint film directly related to the distribution of stress in the fabric. In the top section, where the stress was present in both horizontal and vertical directions, the paint film was uncracked, while in the lower half, where tension is less, cupping and cracking are present. Only one panorama, by Mesdag in The Hague, also had weights along the bottom edge that supplied more tension to the lower half of the fabric; this panorama showed no cracking overall. Berger compared this panorama to an adjacent collection of Mesdag paintings on traditional stretchers, which consistently showed cupping and cracking, and concluded that the excellent condition of the panorama was due to the continuous tension supplied by gravitational pull on the unrestricted painting and its added weights, while the paintings on traditional stretchers lacked this continuous application of tension, causing them to crack.

Berger transferred the principles of the hanging cycloramas to a portable stretcher system (fig. 40). In 1984, Berger presented his design for a continuous tension stretcher in an article for *Studies in Conservation* (Berger 1984). He simulated the constant gravitational tension of the hanging cyclorama by affixing the top and bottom edges of the fabric to the top and bottom stretcher members. Vertical expansion and contraction of the fabric due to climate changes was accommodated by a series of springs along the upper movable member, which responded to movement in the fabric, keeping the tension in the vertical direction constant. The vertical edges of the fabric were not affixed to the stretcher, but rather were fitted with sleeves containing a metal rod. Because the vertical edges were not affixed to the stretcher, they were able to move freely in the vertical direction, following the rest of the canvas. These sleeves, which wrapped around the back of the stretcher, were held in the horizontal direction with a series of springs, which allowed horizontal changes in fabric dimension while retaining constant tension (Berger and Russell 1988).

The painting is only minimally attached to the stretcher wood in order to allow movement overall in both thread directions (vertical and horizontal). The successful use of the stretcher depends in large part on proper mounting of the painting.

Materials/Fabrication

The basic design of the stretcher is essentially a strainer, with only the top member including a movable bar (fig. 41). The strainer is built to the required dimensions, with a beveled profile. An additional profile is cut into the members to accommodate a Mylar or canvas insert, which Berger believes contributes to buffering environmental changes.

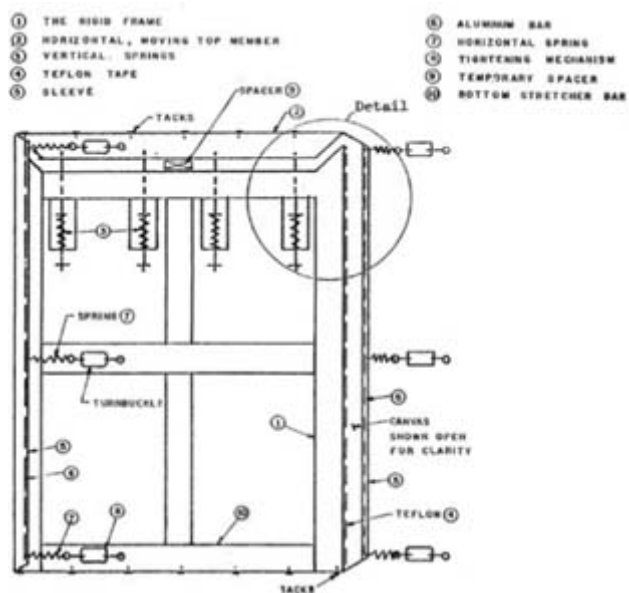


FIGURE 41 Berger's self-adjusting, continuous tension stretcher design

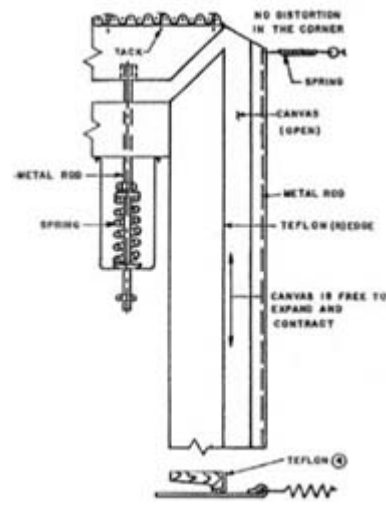


FIGURE 42 Detail of Berger's self-adjusting tensioning mechanism

To stretch the fabric, the top and bottom tacking edges of the painting are attached to the movable wooden top bar of the fixed strainer and the bottom of the strainer respectively. A series of springs along the moveable top bar allow constant tension to be applied to the vertical threads (corresponding to the tension of gravity in the cycloramas). This tension is adjusted by bolts in the springs and is set at an acceptable level of tension once the painting is on the stretcher.

The vertical tacking edges of the painting are not attached to the wood of the stretcher, because doing so would restrict vertical thread expansion at the edges. Instead, a strip lining with a pocket is attached to each vertical edge to accommodate a metal bar that holds the fabric straight. The vertical tacking edges, with the attached bars, are wrapped around the vertical sides of the stretcher as in a traditional stretching, but are not affixed to the stretcher (fig. 42). Rather, several springs are attached between the fixed wooden strainer and the bars, which allow the horizontal threads to expand and contract under constant tension. To further facilitate the movement of the fabric, the vertical sides of the stretcher are covered with Teflon® to reduce friction.

Conservation Use: Advantages and Disadvantages

Berger's research and observations of the cyclorama paintings present compelling evidence for the effectiveness of this type of tensioning system. At first glance, the continuous tension offered by Berger's stretcher appears much the same as that offered by other continuous tension stretchers that employ corner springs. However, the advantage of Berger's system is that the tension supplied by the springs is more uniformly distributed along the length of the side, as opposed to corner springs, where expansion is primarily at the corners. Berger himself argues the superiority of his design on the merit of the fixed frame; he feels that as corner spring designs open, the open stretcher corner weakens the overall structure of the stretcher, while his rigid frame, which does not open, remains stronger.

A purist may argue that while Berger's design allows for great movement of the canvas in both the horizontal and vertical directions, movement is restricted along the tacked horizontal edges and the added strip linings on the vertical edges impact movement of the fabric where they are attached. However, the design appears to provide the greatest amount of uniform, overall tension to the stretched fabric and could be of great use for paintings that must be placed in unstable environments.

Practically speaking, the complex stretcher design presents a challenge in properly using the stretcher, and one may question how well the stretcher and its painting will fare once out of the conservator's hands, particularly if it is subjected to misguided attempts to adjust the tensioning system. In order to properly stretch the fabric, procedures must be carefully followed. For example, the pocketed strip linings must be securely and squarely attached to the vertical edges of the painting so that the painting will be square when stretched.

Artist/Contemporary Use

According to Laszlo Cser (c.1995) no artists are using the continuous tension stretcher for their original work. The complex design and the required modifications to the painting fabric probably preclude common use for new paintings and may also limit its use in conservation situations as well.

Individual Bar Control Stretchers

Historical Review

In 1992, Stan Phillips, an artist and woodworker, introduced his Individual Bar Control (IBC) stretcher design during the Paintings Specialty Group session at the annual AIC meeting (Phillips 1992a). Phillips developed his design in response to his desire to create a stretcher that could be expanded in one direction at a time. He based his premise on the idea that in the weaving process, the warp and weft threads of the canvas are under different amounts of tension, which translates, in the final fabric, to a varying ability to respond to further changes in tension. Thus, he predicts that in a typical stretched fabric, to maintain a taut surface, one set of thread elements (either the warp or weft) will require a greater amount of tension than the other. Subsequently, as the canvas becomes slack and requires keying out of the stretcher, one set of threads may require more tension than the other.

Phillips saw the problem with traditional stretchers, which only expand at the corners, as contrary to the unique tension needs of the two thread elements: when keyed out, both warp and weft threads are put under the same amount of tension. This is because the traditional stretcher is keyed out by means of the force of the key being exerted on both stretcher bars and the two bars moving apart. The extent to which the two bars move apart is stopped by the resistance of the canvas threads to further stretching. Thus, in Phillips's estimation, there is great probability that the set of threads with the least available stretch will be put under undue stress to provide sufficient tension for the other thread elements.

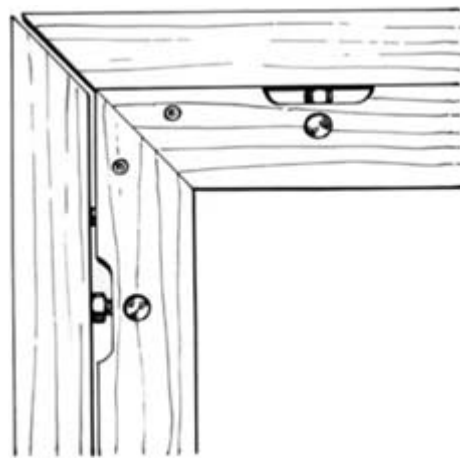


FIGURE 43 Individual Bar Control (IBC) Stretcher

Phillips's solution to this problem was to design a stretcher in which the tension of each side could be adjusted independently of all other sides, enabling the set of threads requiring greater tension to be stretched further, while leaving the other threads under less tension. Expansion in the IBC stretcher is achieved by means of a series of turn bolts that hold each bar in the expanded position without the possibility of compression offered by springs. Thus, the IBC stretcher does not truly offer the continuous tension of other spring stretcher designs. It is, however, possible to manually adjust the tension by means of the turn bolts whenever necessary, much in the way it is possible to adjust a turn bolt stretcher design.

Materials/Fabrication

Phillips constructed the IBC stretcher of basswood. It consists of a fixed inner frame, with moveable outer frame members attached by wooden dowels and adjusted with expansion bolt inserts (fig. 43). The four-member, rigid inner frame is permanently joined at the miters with mortise and tenon construction, held by screws. Depending on the size of the stretcher, the inner frame may also be fitted with fixed crossbars.

Each side of the inner frame is fitted with a moveable, abutting outer bar. This bar reflects the traditional profile of a stretcher, with a beaded edge and corners cut on a miter. The outer bars rest on wooden dowels that protrude from the internal frame and are the only means by which the outer bars are held in place. (Originally, Phillips used fiberglass dowels [doweled] to reduce friction on the moveable [moving] bar, but had problems with the dowels remaining attached in the fixed inner frame [[[#ref96 | Phillips 1992b]]]. He turned to wooden dowels because he felt they offered greater stability in the inner frame, though acknowledging that a small amount of friction was also introduced into the moving bar.) Evenly spaced expansion bolts are inserted into the inner frame and as they are turned, the bolt heads push against the adjacent edge of the outer bar, providing the expansion force. When any of the bars is open, the miters at the corresponding corners also open.

Conservation Use: Advantages and Disadvantages

The IBC stretcher has found conservation use primarily as a replacement stretcher for damaged, ineffective, or missing stretchers (German-Carter 1999). Because each side offers individual control at each expansion bolt, it is particularly useful for out of square or otherwise distorted paintings. Conservators have found it particularly useful for modern paintings, which often have irregular profiles. The outer bar is sufficiently flexible to be bowed if necessary, particularly on larger sizes. Conversely, this can also be a problem if the expansion bolts are placed too far apart and unwanted bowing occurs between the bolts. Careful consideration of the number and placement of expansion bolts along a side helps to customize the shape and adjustability of the stretcher.

The design of the stretcher allows it to be readily adapted for other straight-line shapes, such as pentagons. It is also adaptable to curved shapes, such as ovals and arches. Three large, arched N. C. Wyeth murals were stretched on IBC stretchers by Williamstown Art Conservation Center conservators, who found that the outer bars of the arches, which were constructed of many small sections, offered many points of adjustment for the irregular profile of the paintings (Le Mense c.1995). Other smaller adjustments to the outer profile may be made by carving or adding wood to fit specific irregularities in the fabric (see section 1.1 in *Stretchers and Strainers: Treatment Variations*).

Artist/Contemporary Use

Although the IBC stretcher is available to contemporary artists, few have chosen to use it, most probably due to cost.

Special Considerations

As of June 2000, Stan Phillips has retired from the stretcher business. To date, no one has taken over continued manufacture of the IBC stretcher design, although some conservators have had versions of the stretcher made by local craftsmen as needed. Chassitech, a French company making stretchers and other related materials, makes a stretcher that seems very similar to the IBC design (Ferrer 2002).

Nancy Pollak

Submitted November 2006

Special Considerations

Panel Stretchers

Historic Review

In the United States, panel stretchers are found primarily but not exclusively on paintings by 19th-century landscape painters. However, the earliest use of panel stretchers known to the author is on paintings by John Trumbull (1756–1843), an artist best known for history painting. The Yale University Art Gallery has approximately sixty-eight easel paintings by Trumbull, thirty of which were given by the artist in 1832. The type of stretcher on each of the sixty-eight paintings has not been recorded, but a random examination of approximately thirty of them by conservators

Mark Aronson and Marlene Worhach did reveal panel stretchers on the following paintings, all but one a part of the 1832 Trumbull bequest: *St. Jerome, at Parma*, (after Benjamin West's copy of Correggio's *Madonna of St. Jerome*), 1780, YUAG 1832.94; *The Death of General Montgomery in the Attack on Quebec, 31 December 1775*, 1786, YUAG 1832.2; *The Battle of Bunker's Hill/The Death of General Warren at the Battle of Bunker's Hill, June 17, 1775*, 1786, YUAG 1832.1; *The Death of General Mercer at the Battle of Princeton, 3 January 1777* (unfinished version), c.1786–1788, YUAG 1832.6.2; *The Capture of the Hessians at Trenton, 26 December 1776*, 1786–1828, YUAG 1832.5; *View on the West Mountain Near Hartford*, c.1791 YUAG 1957.24; and *Madonna and Child with St. John the Baptist* (copy after a copy of Raphael's *La Belle Jardinière*), 1801, YUAG 1832.98. An eighth painting, *Sortie from Gibraltar*, 1788, in the Cincinnati Art Museum, is documented as having originally been on a panel stretcher.

Interestingly, all of these paintings except for *View on the West Mountain Near Hartford* were begun in London, and most were painted either in the studio of Benjamin West (1738–1820) or under his tutelage (Cooper 1983, 8, 9, 54, 185, 194, 220). It is tempting to hypothesize that Trumbull was influenced in his choice of stretchers by London artists, particularly West, but at present there is no evidence that panel stretchers were used in London in the 18th century, although they do become popular in the second half of the 19th century, particularly with the Pre-Raphaelites. Sally Woodcock, Research Associate, Roberson Archive at the Hamilton Kerr Institute, has found numerous references to panel stretchers in the accounts of Ford Madox Brown (1821–1893). In the National Museums and Galleries on Merseyside: Lady Lever Art Gallery, panel stretchers are found on paintings by William Holman Hunt (1827–1910), Samuel Luke Fildes (1844–1927), Edward Burne-Jones (1833–1898), Dante Gabriel Rossetti (1828–1882), and G. D. Leslie (1835–1921) (Stainer-Hutchins). At the Victoria and Albert Museum, Rossetti's *The Day Dream* (1880) has a panel stretcher (Costaras 1998). At the Royal Academy of Arts, three Victorian paintings with panel stretchers have been identified: Frederick Richard Pickersgill, RA, *The Bribe*, 1857 (Diploma Work); George Henry Boughton, RA, *Memories*, 1896; and Frank Cadogan Cowper, RA, *Vanity*, 1907 (Horowitz 1997).

Panel stretchers do occasionally occur on English paintings from the early 19th century, but the subject is complicated by use of these stretchers by restorers in the latter part of the century. A painting by Jean François Millet (1814–1875) titled *La Nuit Etoilée* (c. 1851) in the Yale University Art Gallery has the following inscription on a label on the back of the stretcher:

This picture “Nuit étoilée” was sold at the sale of Millet's pictures on 11th. May 1875. I bought it from Goupil on the 26th. of Feb. 1878. It was lined with a strong canvas. Placed on a panelled strainer at the suggestion of Holman Hunt-by Mr [?] Eatwell-on the 15th of February 1879 Mr. Eatwell took the seal from the old frame & stuck it on this one- Geo. Lillie Craik

Therefore, early examples of English panel stretchers must be approached somewhat cautiously as it is possible that the painting may have been mounted on the stretcher at a later date. For instance, *Salisbury Cathedral* (c. 1829) by John Constable (1776–1837) in the Tate Gallery is an early example of a panel stretcher, but because the tacks have been replaced Stephen Hackney feels that “it is just possible that this is not the original stretcher” (Hackney 1996). I know of no instances in the United States where paintings were remounted on panel stretchers by restorers; in fact, it is far more likely that restorers removed these stretchers during lining.

Given the lack of evidence for panel stretchers in 18th-century London, it seems most likely that Trumbull (re)mounted his paintings in the United States on panel stretchers that he had made here, perhaps in part because he shipped them from London unstretched. Certainly this would have been the most economical method. He made detailed inventories of the goods he shipped to and from London in 1803, 1808, and 1813 (New York Historical Society); some paintings were shipped framed, which would indicate that they were stretched, but others were unframed and could have been unmounted. There is only one mention of rolled canvases, but he notes some paintings tied together so it is possible that he sandwiched unstretched paintings.

In addition, the panel stretchers on Trumbull's paintings at Yale are all fairly sophisticated in construction with double keys, which, according to Alexander Katlan (2006), places them in the 19th century and supports the theory that Trumbull had new stretchers made for the English paintings after he returned to America. On the reverse of the panel stretcher of *St. Jerome at Parma* (1781), there is an old, seemingly original, label inscribed “The Property/of/ John Trumbull/1794,” apparently referring to the date the label was affixed. It is possible to infer that this is also the date of the stretcher, but if so, it is a very early example of doublekey construction.

Legend credits Trumbull with having “discovered” Thomas Cole (1801–1848) in 1825 (Truettner and Wallach 1994, 23–24). Certainly, Trumbull was an important patron of Cole, and it is possible to hypothesize that he passed along his use of panel stretchers to the younger artist. The earliest panel stretcher known to the author on a Thomas Cole painting is dated 1836 (stretcher preserved by Alan Farancz, New York City). Panel stretchers have also been found on the following paintings: *The Departure* and *The Return*, dated 1837 on the paintings as well as on the reverse of *The Departure's* stretcher, and *Return from the Tournament*, dated 1841, all in the Corcoran Gallery of Art; *The Tower*, 1839, in the Currier Art Gallery and *Mount Etna from Taormina*, Sicily, 1844, in the Lyman Allyn Museum (Mayer and Myers 1996, 2006); and a landscape thought to have been painted in 1848 (stretcher again preserved by Alan Farancz).

Cole purchased frames, stretchers, and mahogany panels from the firm of Parker and Clover in New York City. Alexander Katlan reproduces Cole's bill for the period from April 14, 1827 to August 21, 1833 (Katlan 1992, 494–502). Of the fifteen stretchers listed, all but one range in price from \$.25 to \$2.00. The exception is described as “1 large stretcher” priced at \$15, and Katlan hypothesizes that the high price, comparable to that of some of the frames, might indicate a panel stretcher. This is certainly possible, since these stretchers were made by skilled woodworkers, and Parker and Clover specialized in carved and gilded frames and decorative ornaments. Parker & Clover did not go out of business until 1844, four years before Cole's untimely death, so it is possible that they provided him with stretchers for most of his career. However, it is also possible that he found another supplier after 1833 that made panel stretchers.

Panel stretchers have also been found on paintings by other members of the Hudson River School, for example, *In the Woods*, 1855, Metropolitan Museum of Art, by Cole's friend and colleague, Asher B. Durand (1796–1886) (Prins 1989, 24–28). There is also an unusual arched panel stretcher on a painting of *Janetta Falls, New Jersey*, 1846, Santa Barbara Museum of Art, by Cole's follower Jasper F. Cropsey (1823–1900) (Court 1996), and it is apparent that Cole passed along the use of panel stretchers to Frederic Edwin Church (1826–1900), who was his student from 1844 to 1846 (Kelly 1989, 183). Among the paintings by Church known to be on panel stretchers are *Tequendama Falls, near Bogota, New Granada*, 1854, in the Cincinnati Art Museum; *Sunset*, 1856, Munson-Williams Proctor Institute; *Cayambe*, 1858, The New-York Historical Society; *The Icebergs*, 1861, Dallas Museum of Art; *Aurora Borealis*, 1865, National Museum of American Art; *Morning in the Tropics*, 1877, National Gallery of Art; and *The Monastery of Our Lady of the Snows*, 1879, The Cleveland Museum of Art.

In 1858, Church moved into the Tenth Street Studio Building, 15 West Tenth Street, New York City (Kelly 1989, 163). New York was the center of the American art world, and the Tenth Street Studio was “the hub of that community” (Anderson and Ferber 1990, 23). Albert Bierstadt (1830–1902) moved into the Tenth Street Studio at the end of 1859, and it seems likely that he discovered Church's panel stretchers around this time since they begin appearing on his paintings in the 1860s. He continued to use panel stretchers to the end of his career (along with stretchers without panels), and by far the largest number of these stretchers have been found on his paintings.

In her research on Frederic Church, Joyce Zucker discovered in the Church papers at Olana State Historic Site an invoice dated June 8, 1861, from Charles C. Schmitt to Church for a panel stretcher. Schmitt was a cabinetmaker specializing in making artists' furnishings in a shop near the Tenth Street Studio (Katlan 1992, 39–40). As the Church invoice indicates, the stretchers were sold directly to the artist. Occasionally a colorman's stencil may be found on the reverse of Bierstadt's panel stretchers, for example, *Half Dome*, *Yosemite Valley*, 1866,

Cleveland Museum of Art, has the stencil of the New York colorman Edward Dechaux on the reverse, and *Yosemite Valley*, 1868, The Oakland Museum, and *Giant Redwood Trees of California*, 1875, Berkshire Museum, have stencils from Snow & Mays in San Francisco. It seems unlikely, however, that the stencils are related to the manufacture or sale of the stretcher. The Dechaux stencil was probably added when the canvas was mounted and, as Snow and Mays were dealers as well as art suppliers, it is likely that they had the paintings for sale. In fact, the address given on the Snow & Mays labels, 21 Kearney Street, was their location from 1874–1878, six to ten years after *Yosemite Valley* was painted.

The dimensions of the stretcher parts and the method of construction of Church's panel stretchers from the late 1850s are virtually identical with Bierstadt's panel stretchers from the 1860s, leading to the conclusion that both of these artists may have been using Charles Schmitt as their stretcher maker at this time.

Subtle changes in design and quality of workmanship on panel stretchers occur over the years, suggesting changes in cabinetmakers. In addition, panel stretchers with Wright and Gardner's patented corner sprint mechanism have also been found, primarily on works by Albert Bierstadt. Their label, which is often still found on the reverse of the stretchers, boasts (fig. 44):

This improvement in canvas stretchers, is superior to any frame now in existence because of its novel construction, whereby provision is made for its automatic expansion and contraction in consequence of variations in the weather, also on account of its strength, durability, cheapness, etc.



FIGURE 44 Wright and Gardner label on the stretcher on Albert Bierstadt's *Indian Sunset: Deer by a Lake* in the collection of the Yale University Art Gallery. Photograph courtesy of Lance Mayer and Gay Myers.

Bierstadt used Wright and Gardner stretchers both with and without the panel inserts, and it is possible that they made the panel stretchers at his request. *A Wave Breaking on the Bahamas Coast*, c. 1886, in the Haggin Museum (Cockerline 1996) and *Indian Sunset: Deer by a Lake*, Yale University Art Gallery, are two examples of Bierstadt paintings on panel stretchers with Wright and Gardner spring-loaded corners.

Of the artists of Bierstadt's generation, panel stretchers have been found on *Portland Bill, England* by William Trost Richards (1833–1900) in the Heckscher Museum (Katlan, c.1996) and on *Woodland Temple*, dated 1867 in the Haggin Museum, by Bierstadt's rival, Thomas Moran (1837–1926 (Cockerline 1996). *On the Lagoon* by Sanford Robinson Gifford (1823–1880) in the National Museum of

American Art had a panel stretcher with Wright and Gardner corner springs. Gifford was a friend of Bierstadt's from his student days in Dusseldorf and had a studio in the Tenth Street Building so it is not surprising to find him using a stretcher similar to Bierstadt (Anderson and Ferber 1990, 140). Finally, panel stretchers with Wright and Gardner corner springs also appear on two paintings by Alexander Wyant (1836–1892), *Landscape with Cows*, Battell-Stoeckel Estate, Norfolk, Connecticut, (Mayer and Myers) and *The Cloudy Day*, 1880s, Toledo Museum of Art. In the 20th century, panel stretchers have been found on paintings by Childe Hassam (1859–1935), William Leroy Metcalf (1858–1925), and Arthur B. Davies (1862–1928) (Jones 2006, Mayer and Myers 1996, 2006).

The use of panel stretchers in Europe is beyond the scope of this paper, but it is worthwhile to note that they do not appear to be widespread. In an essay on the distemper paintings on canvas of Andrea Mantegna (c.1431–1506), Andrea Rothe reproduces a photograph of a strainer with wood panels between the cross member found on *The Presentation in the Temple*, Staatliche Museen Preussischer Kulturbesitz, Berlin. Other canvas paintings by Mantegna were attached to panels alone, a practice also found on Netherlandish and German *tüchlein* paintings of the 16th century (Rothe 1992, 80-88).

In Spain, Zahira Veliz reports original strainers with fixed panels, all in pine, on Spanish paintings by El Greco (1541–1614), Luis Tristan (1586–1624), Eugenio Cajés (17th century), Angelo Nardi (1584–1663/5), and Francisco de Zurbarán (1598–1664). Here the paintings were actually glued to the strainers around the outer edges and tacking margins. Contract documents for paintings in Toledo indicate that the stretchers were intended to provide protection from the climate.

These examples notwithstanding, Laurent Sozzani of the Rijksmuseum, Amsterdam, who has been researching the larger subject of historic protective backings for paintings, has not found anything comparable to American and British panel stretchers in Western Europe. However, he notes that concern for protecting large paintings in churches against damp walls begins in the 18th century in Germany and to a lesser degree in France. This fits in with the earlier development of panel strainers in Spain as a protection from the climate. Sozzani speculates that this concern might have spread to the United States with immigrant German cabinetmakers who, working with an artist, might have developed the first panel stretchers. Another possibility is that while in Europe, a well-traveled American artist like Trumbull became aware of the need to protect paintings from the climate. Obviously, much more research needs to be done, and it is hoped that this entry will contribute to the accumulation of such a body of information.

Materials/Fabrication

Panel stretchers have wooden panels inserted into a groove in the sides of the surrounding stretcher bars. These stretchers range from modest-sized to extremely large, but the wooden panels are generally kept relatively small by the addition of cross-members. The stretcher in the illustrations (figs. 45, 46) was removed from Albert Bierstadt's *The Landing of Columbus*, 1892, in The Newark Museum. It is 6 x 10 feet and has one horizontal cross-member separating two rows of ten vertical members. The panel inserts measure approximately 32 x 10 inches. The corner construction is half-mitered (interior) and half-butt joined (reverse). When it has been possible to see both sides of the stretcher, this appears to be the usual construction method, and there are generally slots for keys. Stretcher bars are often pine, but sometimes the panels are a harder wood such as maple, which is less inclined to warp.



FIGURE 45 Exterior of a 6 x 10 foot panel stretcher removed from *The Landing of Columbus* by Albert Bierstadt (1892, The Newark Museum). Photograph courtesy of Alan Farancz.



FIGURE 46 Interior view of the stretcher in figure 45.

On John Trumbull's panel stretchers, at the interior corners formed by the butt joints, a wedge-shaped piece of wood has been cut out of the surface of one of the stretcher bars to allow for the insertion of the uppermost key. I have not seen this type of construction in later panel stretchers.

Panel stretchers with Wright and Gardner's patented (1875) spring corner mechanism have also been found, primarily on works by Albert Bierstadt (figs. 47, 48).

Conservation Use: Advantages and Disadvantages

The excellent state of preservation of many paintings mounted on panel stretchers has been noted by conservators. Craquelure can be virtually nonexistent and, in the relatively few paintings that have escaped lining, the canvas can still provide an adequate support, even for large paintings. This is undoubtedly due to the fact that the wood panels have provided a protective barrier for the canvas. Dirt and atmospheric pollutants have been kept away from the bare fabric, and the effects of damp walls have been mitigated. Since the wood acts as a humidity buffer, the problem of expansion and contraction of the fabric and sizing, caused by fluctuations in ambient relative humidity, is reduced, thus reducing the cracking and cupping of the paint and ground layers. Stretcher creases have been lessened because the environmental differential between exposed canvas and canvas covered by the bars of ordinary stretchers/strainers is eliminated. Finally, the panel back has provided additional support for the canvas and protected the painting from blows.



FIGURE 47 Panel stretcher with Wright and Gardner's patented corner spring mechanism: detail of spring mechanism. The stretcher is on Albert Bierstadt's *Indian Sunset: Deer by a Lake* in the collection of the Yale University Art Gallery. Photographs courtesy of Lance Mayer and Gay Myers.



FIGURE 48 Overall view

Thomas Cole's *The Departure* and *The Return* are good examples of the efficacy of panel stretchers, particularly when coupled with glazing. The paintings were gifts of the Corcoran's founder in 1869, and for most of their history they endured an environment without air-conditioning or relative humidity control, including tropical Washington summers when, according to legend, the upstairs galleries were often closed because the heat and humidity were too much for guards and visitors. Nevertheless, they have survived with minimal cracking and loss in the paint and ground layers.

It is clear from a letter written by Albert Bierstadt on June 27, 1877, to William Macleod, Curator of the Corcoran, that artists were perfectly aware of the efficacy of panel stretchers:

I have had a talk with Mr. Volmering [presumably the artist Joseph Vollmering 1810–1887], who in my opinion is as well informed as any man I know of in this country upon matters connected with the restoration and preservation of pictures. He says that in Berlin and Vienna the principle galleries have had the backs of the stretcher frames covered with calico or thin cloth and then covered with shellac and glue. This keeps out all moisture and dust and preserves the canvas. The panel back does the same and I generally have both sides covered with shellac before the canvas is put on. This prevents the wood from absorbing moisture in any way and I think it very rare that even in dry times the canvas remains tight whereas in the ordinary stretcher the canvas is tight or loose according to the weather. This must be bad. The colors we use are not elastic like rubber, and consequently the picture must crack in time... It stands to reason that dirt in any form is bad for a picture, it is sure to rot the canvas in time and I have known of so much dirt collecting upon the back of a canvas as to sustain vegetable [sic] life. You can understand this when a picture hangs against a damp wall. (Director's Correspondence File, Corcoran Gallery and College of Art Archives, Washington, DC)

Laurent Sozzani reports that at the Kunsthistorisches Museum in Vienna, they find traces of cloth having been glued to the backs of frames in the 1890s.

The only real disadvantage of panel stretchers is their weight, which for large paintings can be significant. This is probably one reason that many panel stretchers have been discarded, often at the time of lining. There is also the concern that paintings need more air circulation in order to prevent mold growth. Although mold growth is possible under certain very adverse climatic conditions, this is not a problem in many areas of the country and certainly not in institutions with climate control.

Artist/Contemporary Use

Contemporary artists and conservators generally do not use stretchers of the design described above. It has become common practice to affix a backing board (see section 14 in *Stretchers and Strainers: Treatment Variations*), usually made of lightweight archival-quality corrugated paperboard or an inert extruded twinwall polypropylene (i.e., Coroplast®), to the reverse of the stretcher, and to some extent this provides a lightweight alternative to a panel stretcher; however, it does not replicate the close proximity of the canvas to the panel, which has the added advantage of providing support to the canvas, reducing vibrations during transport and minimizing the damage of surface blows. For this reason, some conservators have designed methods of modifying traditional stretchers to simulate the effect of panel stretchers, often using contemporary materials (Beltinger 1995, 111-118; Prins 1989, 24–28) (see section 4 in *Stretchers and Strainers: Treatment Variations*).

Special Considerations

Every effort should be made to maintain a painting on a panel stretcher. The efficacy of the design coupled with its historic importance generally outweighs other considerations, such as increased ease of handling with a new stretcher.

Author's note: The following conservators and curators were consulted for this article: Nancy Anderson, Sarah Fisher, David Bull and Michael Swicklick, National Gallery of Art, Washington, DC; Mark Aronson and Marlene Worhach, Yale University Art Gallery; Neil Cockerline, San Francisco Museum of Modern Art; Elizabeth Court, Balboa Art Conservation Center; Alan Farancz, New York City; Sian Jones, Baltimore, MD; Alexander Katlan, Flushing, NY; Lance Mayer and Gay Myers, Lyman Allyn Art Museum; Cindy Lou Ockershausen, National Portrait Gallery; Stefano Scafetta, National Museum of American Art; Joyce Zucker, New York State Office of Parks and Recreation; Simon Bobak, London; Nicola Costaras, Victoria and Albert Museum; Stephen Hackney and Dr. Leslie Carlyle, Tate Gallery; Isabel Horowitz, Royal Academy of Arts; Viola Pemberton-Pigott, Royal Collection, London; Sally Woodcock, Roberson Archive, Hamilton Kerr Institute; Katherine Stainer-Hutchins, Walker Art Gallery, Liverpool; Zahira Veliz, London; Laurent Sozzani, Rijksmuseum, Amsterdam. Research was also carried out in the painting files of the following conservation labs: Intermuseum Conservation Laboratory, Oberlin, Ohio; National Museum of American Art, the Williamstown Regional Art Conservation Laboratory Inc., and the Royal Academy of Arts, London.

Dare Myers Hartwell with Ross Merrill

Submitted March 2007

Stretchers for Double-Sided Paintings

A review of published case studies by conservators on the treatments of double-sided paintings reflects changes in attitudes and approaches. A 1978 treatment summary by Pierre Boissonnas, for example, presented detailed measures to separate the two painted sides of a single canvas (P. Boissonnas 1978). Conservators have more recently described ways to allow paintings on the reverse once neglected, over-painted, and covered by lining pastes and fabrics to be viewed by thoughtfully designed presentations. The resolution of complicated structural problems, often resulting from former treatments and from the nature of being double-sided, has also been addressed. Current treatment practices often evolved from earlier case studies that described the innovative use of synthetic, transparent materials and inventive stretcher designs.

A 1940 case study by Sheldon Keck, published in *Technical Studies*, proved to be a “point of departure for further experiments in the use of synthetic plastics and supports for paintings” (Keck 1940). His treatment, the application of a transparent solid support to the reverse of an Italo-Byzantine icon, allowed for the continued access to information on the reverse despite a structural intervention to the back. In Alain Boissonnas's case study, in a 1961 *Studies in Conservation*, glass-fiber fabric and wax-resin adhesive provided the solution that allowed an important artist-written inscription to be viewed. He also restretched the painting on a Lebron expansion bolt stretcher, finding that use of this new stretcher type for wax-resin impregnated paintings was “very effective and will prevent our endless frustrations in dealing with buckled paintings” (A. Boissonnas 1961). Boissonnas's treatment was an alternative to cutting windows in lining canvases, other translucent lining methods, and mounting the canvas on plastic.

Recent treatment summaries describe the continued use of transparent support fabrics and adhesives, but the conservator today has many more options in customized stretcher designs for double-sided paintings. Stretchers for double-sided paintings are designed to allow both sides of the canvas to be viewed while providing an unobtrusive auxiliary support. Conservators developed numerous supports to display double-sided paintings, including adjustments to original strainers and variations on the continuous tension stretcher, expansion bolt stretcher, and modular aluminum frame. Each stretcher solution outlines new possibilities for the display of full sight size of images on both sides of the work while avoiding the use of cross-members, which would interrupt the image on one side of the canvas. Some of the following stretchers are described in further detail in section 2. The following material is organized in sections that correspond to the different stretcher entries in the rest of this book; the different stretcher constructions include brief historical reviews and a summary of materials and fabrication for each design. Additional notes on some of the designs are presented by the conservators in section 3 in *Stretchers and Strainers: Treatment Variations*.

Continuous Tension Stretchers

Historical Review

In the early 1980s, Barry Bauman modified an ICA Spring Stretcher by halving it parallel to the picture plane. The strip-lined tacking margins of the painting were sandwiched between the halves of the stretcher, which he refers to as the “movable frame liner.” His double-sided frame included a channel that enclosed the movable frame liner and attached spring mechanisms (Bauman 1982) (figs. 49, 50). Bettina Jessell used Bauman's design in 1989 for a George Bellows painting that had a portrait on one side and a landscape format image on the other (Jessell 1989) (fig. 51). In a 1992 case study published in the Munich-based journal *Restaura*, Bernd Bünsche treated a double-sided work by a 20th century German artist. Bünsche designed a continuous tension system that used U-shaped strips of Plexiglas® to clamp the tacking margins, secured with screws (Bünsche 1992). In Italy two years later, Eugenie Knight and Paolo Pastorello independently designed a similar continuous tension system for the treatment of double-sided processional banners. Their continuous tension system is enclosed in a steel frame, mounted on a base, and allowed to pivot so that the two sides of the banners are easily accessed (Knight and Pastorello 1994). More recently, Franco del Zotto designed a series of continuous tension systems, referred to by the author as “auto-adapting suspension,” that stemmed from his lengthy research on the multiple-layered “elastic” systems of canvas paintings. His systems are based on constructions with a series of spring-loaded mechanisms enclosed within two halves of a wooden frame (del Zotto 2002). Variations on this basic design as well as detailed explanations on Maximum Sustainable Tension (MST), load, load frequency and dissipation of energy, spring linear elasticity, and nonlinear kinematics are presented to support the designs and published in *Preprints, 13th Triennial Meeting ICOM-CC, Rio de Janeiro, 2002*.

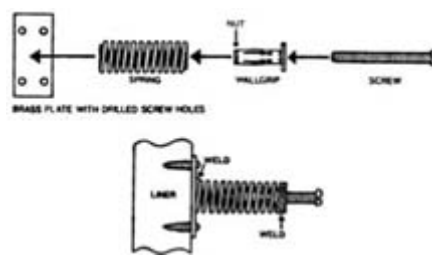


FIGURE 49 Liner spring mechanism (Bauman 1982)

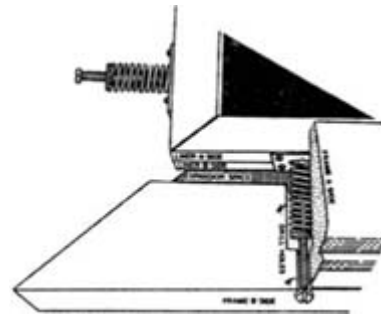


FIGURE 50 Assembly of frame, liner, and painting canvas (Bauman 1982)

Materials/Fabrication

Bauman first took measures to ensure that both sides of the painting would be registered and centered within the liner halves by using a squared Mylar® template as a guide for both sides of the painting. His aligning method, described and illustrated in detail, is still worth reviewing for a treatment carried out today regardless of the double-sided stretcher design. In his design, strip-lined edges of the painting were tacked onto one set of two identical, gilded liners/stretchers. He constructed a spring mechanism with an extra small “star wall-grip” welded to one end of a medium-gauge spring (fig. 49). A thin brass plate was welded to the other end of the spring. Screw holes were drilled into the brass plate just inside each of the four corners. The two liners were then joined by inserting wood screws through the holes in the brass plates and into the sides of the liners so that the two now act as one. Three spring-mechanisms were attached to each side. The molding of the two identically designed frames was as wide as the length of the spring mechanism. Holes were drilled in the appropriate positions to enclose the springs; a second hole, to contain the adjusting screw, was drilled from the outside of the frame to align with the center of the spring. The two frames were joined with mending plates. Adjusting screws were threaded until contact was made with the nut at the end of the wall-grip. By tightening the adjusting screws, the liners and spring mechanisms are pulled outward, stretching the canvas to the desired tension (Bauman 1982) (fig. 50).

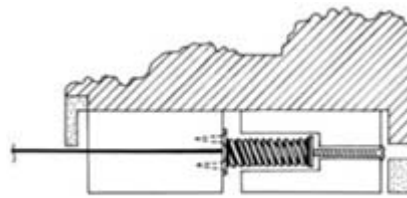


FIGURE 51 Section through stretching structure (Jessell 1989)

Jessell's 1989 paper described an adaptation of Bauman's stretcher for treating a double-sided George Bellows painting. Jessell tacked the painting margins onto the bottom half of the split stretcher and the two halves were joined together with screws. Eighteen tension mechanisms were fitted into the edges and paired with holes drilled into the support frame for adjustment of tension (fig. 51). Additional smaller holes were drilled into the frame to allow for adjusting the tension without unframing the whole construction. Jessell added a gilded shadow liner to fill the gap between the paint surface and inner edge of the late Whistler-type reeded frame and a second gilded surface on the outer edge of the frame to conceal the gap between wall and frame introduced by the stretcher. Hanging hardware was modified to allow either landscape or portrait format to be viewed in the frame. The double-sided painting would have to be unframed and then reframed with the image on the opposite side facing outward. Jessell thought it would be ideal to construct a carriage framework that would turn the painting 90 degrees to accommodate the different landscape/portrait formats for each side of the painting but concluded it would be too cumbersome in a private home where this painting was exhibited (Jessell 1989).

Bünsche's design may require material to be uniquely engineered for his continuous-tension stretcher; it used lengths of Plexiglas®, with a clamped U-shaped cross section. Holes, aligned with the original tacking holes of the painting, were piloted in the Plexiglas® through which a screw is threaded and fastens the Plexiglas® and original tacking margins with a bolt. At the bend in the U of the Plexiglas®, additional holes were made through which ends of springs were threaded and clamped onto a wire running through the length of the U-shaped Plexiglas® strip. The other ends of the springs were fastened to screws fixed into the outer decorative frame. Because the painting lacked a frame, a new double-sided wooden one was constructed in a design doweled together to encapsulate the Plexiglas® and tensioning system (Bünsche 1992).

Replicating the procedure used by Knight and Pastorello requires special materials. They designed a stretcher made of a four-member steel frame, bolted in its corners, containing a continuous tension system within its hollow cross section. Strip linings were adhered along the original tacking margins of the large processional banner and sewn, using a polyamide thread, to a PVC strip with a T-shaped cross section. Prior to attaching the canvas and strip lining, the PVC strip was perforated with holes in preparation for sewing with polyamide thread. Every few centimeters along the margins of the strip lining a spring mechanism was attached. Ends of the tension devices were enclosed in a steel frame that also served as the mounting carriage. This design was meant to ensure even distribution of the tension of the nearly 150 tension mechanisms along the length of the canvas margins. The conservators designed a mount on which the steel framework pivoted, allowing both sides of the banner to be viewed by turning on its axis (Knight and Pastorello 1994).

Del Zotto's configuration for the “auto-adapting suspension system” is a sophisticated and complex construction that would require special materials for fabrication in a studio. His basic design for the continuous tension stretcher consists of regularly spaced spring-loaded plungers enclosed within two halves of a decorative wooden frame. The springs are fixed to lengths of aluminum with a C-shaped cross section that grip strip linings along the perimeter of the double-sided painting. Within the lengths of aluminum, segmented hardwood is enclosed to reinforce the purchase to the strip linings. Each spring-loaded plunger has a counterpart tensioning register, accessed when the decorative exterior frame is lifted, to optimize the desired tension conditions for the canvas. Pressure latches connect the two halves of the frame, allowing for easy access to

the internal mechanisms. He modifies this basic design by proposing a more compact “bayonet” model, a model with interior mechanisms lined with Teflon® and a model to which a nonlinear kinematic link was introduced to the spring “to avoid the progressive increase in tension with displacement from the linearity of springs” (Del Zotto 2002).

Expansion Bolt Stretchers

Historical Review

During an internship at the Center for Conservation and Technical Studies at the Fogg Art Museum, Lenora Rosenfield restretched a double-sided painting by Robert Henri on a customized Lebron expansion bolt stretcher (Rosenfield 1993). In 1996, Gillian McMillan used a similarly designed expansion bolt stretcher made out of cherry wood by Simon Liu, Inc., to restretch a double-sided Cézanne (McMillan 1996). Scott Heffley modified the expansion bolt stretcher by introducing a steep bevel to one side of the stretcher. The expansion bolts were not visible on the beveled side, which doubled as a decorative frame. Heffley's design accommodates for glazing the paintings (see section 3.1 in *Stretchers and Strainers: Treatment Variations*).

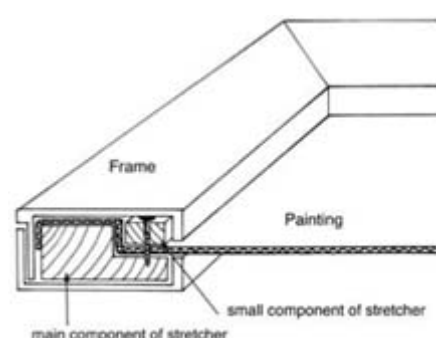


FIGURE 52 Attaching the stretcher to the frame (McMillan 1996)

Materials/Fabrication

The design of Rosenfield's stretcher was proposed by Lebron who used relatively wide stretcher members. A special edge on the back formed a rabbet, and pieces of wood strips fit into the rabbet to form a surface that was flush. The canvas was strip-lined with monofilament polyester and secured with closely spaced staples for evenly distributed tension (Hensick 1999, Rosenfield 1993).

Similarly, in the Simon Liu, Inc., design used by McMillan, thin and mitered members fit into the rabbet of larger members having an L-shaped cross section. Linen strip linings were adhered to the tacking margins and attached first to the larger L-shaped component. The thinner members were applied in the rabbet of the larger member and fastened with screws. Excess strip lining margins were visible on the surface, but hidden under a simple frame that enclosed the construction (fig. 52). McMillan's design accommodates glazing for protection between the stretcher and frame (McMillan 1996).

Scott Heffley stretched a double-sided painting on an expansion bolt stretcher with single components whose surface was steeply beveled on one side. He used the beveled side of the stretcher as a frame on the side that displayed the secondary painting. Strip linings were applied to tacking margins and fixed to the flush surface, that is, the surface with the exposed turnbuckles. A frame assembly included a liner that concealed the strip lining and exposed turnbuckles. An additional frame element could be applied to accommodate glazing. He recommended anticipating the requirements of the frame appearance when designing the stretcher—such as width, depth, and angle of bevel—in addition to the quality of wood for staining, veneering, or gilding. (See Heffley's more detailed description and illustrations of the design in section 3.1 in *Stretchers and Strainers: Treatment Variations*).

Aluminum Stretchers

Historical Review

Berger's treatment of a double-sided work of art on paper explains an innovative use of BEVA® formulas. His 1996 publication gives a detailed account of the use of his trademark material, which is an essential element in the treatment of a Rouault transparently lined with Stabiltex® and Mylar®. Berger's use of a ready-made modular aluminum frame is the first documented use of such a stretcher for the display of double-sided works of art. He wanted to use a “strong, yet thin” stretcher to restretch the Rouault with images on both sides. Berger credits Soren Bernsted, who presented a similar method to provide a transparent lining of a transparent painting in 1993 (Berger 1996, Bernsted 1993). His aluminum stretcher, unlike the Starofix aluminum stretchers (see section 2.4.1) does not have continuous tension mechanisms. The aluminum frame is made keyable by mounting the aluminum onto Plexiglas®, which also provides a transparent, solid backing for the painting. His publication also includes a description of the steps to follow for lining removal. Unfortunately, his article gives a schematic diagram only for the keyable mechanism of the frame; no detailed diagram of the layering of materials for the lining is included.

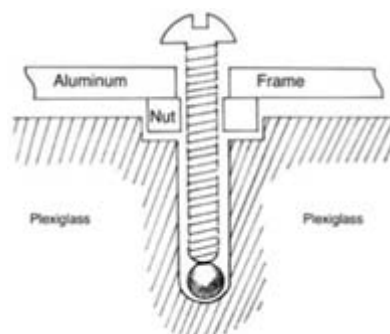


FIGURE 53 Diagram of stretcher made for Rouault (Berger 1996)

Materials/Fabrication

A sheet of 1 cm thick Plexiglas® was framed with pieces of ready-made, modular aluminum frame. The dimensions of the aluminum stretcher were slightly larger than the image. Holes were drilled at 15 cm intervals and screws were threaded in bolts between the Plexiglas® and the aluminum to allow movements in the material. He equipped the aluminum and Plexiglas® with a keying mechanism that used screws pressing against ball bearings located at the base of the holes in the Plexiglas®. Turning the screw caused the nuts to thread up the screw and push the aluminum frame outward to increase the tension of the painting (fig. 53). Berger later added that, if he carried out the treatment today, he would consider substituting Lexan®, a clear polycarbonate made by DuPont, for the Plexiglas® (Berger 1996).

Original Support

Historical Review

David Goist determined that a double-sided painting, *Virginian Luxuries* (landscape format) and *Portrait of a Man* (portrait format), was on its original strainer and in original format (figs. 54, 55). Rather than replace the original construction, he restretched the painting on the original strainer. The frame hid excess tacking margins from a new strip lining. A new frame for the secondary painting was created from stock molding and was stylistically compatible with the original frame on the front (Goist 1996).

Materials/Fabrication

Because he determined that the strainer was original and that its condition was satisfactory, David Goist remounted the double-sided painting onto the original strainer. A frame for the image on the front of the canvas was secured to the strainer with four screws that passed through the back of the wood, through the painting, and into the frame. Using stock strips of molding, a second frame was made in a similar style to frame the image on the reverse. Black felt was adhered to the perimeter of two pieces of Plexiglas®, which served as both glazing and spacers. The two frames that sandwiched the painting and Plexiglas® pieces were secured by four two-inch machine screws that passed through the new frame and into the original molding where four piloted insets received the machine screws. Goist added that the owner found the framing system flexible enough to exhibit both sides at the same time or hang the painting on the wall and exhibit only a single side (Goist 1996).



FIGURE 54 *Virginian Luxuries*, after treatment, recto. Photograph by David Goist.



FIGURE 55 *Virginian Luxuries*, after treatment, verso. Photograph by David Goist.

Keyable Stretchers

Historical Review

Steven Prins has been working with stretcher designs for double-sided paintings for years and presented an example of his models at a Tips Session at the Annual WAAC Conference Meeting in 2004. Prins proposed a modification to the traditional keyable wooden stretcher to fulfill demands presented by his private clientele with works painted on both sides. Traditional keyable stretchers are generally not suitable for the display of double-sided paintings because the wooden keys in the corners interfere with the image found on the “reverse” side of the stretched canvas. Prins's designs modify the traditional stretcher by incorporating the tensioning keys into the outer perimeter of the stretcher. His designs also present some latitude in materials and details so that, with additional modifications and planning, the stretcher could function as frames for both images even when presented with portrait and landscape formats in one work (Prins 2004).

Materials/Fabrication

Refer to section 3.2 in *Stretchers and Strainers: Treatment Variations* for Steven Prins's contribution on his numerous and thoughtfully designed stretchers for double-sided paintings.

Conservation Use: Advantages and Disadvantages

Advantages

There is flexibility in many of the designs outlined above that accommodate special display needs such as glazing and framing options. In all cases where the continuous tension stretcher was used, no metal crossbars or plates in the miters were required. The stretcher was, in each instance, discreetly enclosed within the frame or a framework that prevents visibility of the intricate spring-mechanism system. For conservators with concerns regarding the ability to control the tension for a painting, the introduction of tension adjustment screws allows the compression of the springs to be individually regulated. An attractive feature of continuous tension stretchers and expansion bolt stretchers is their lack of keys, which could possibly interfere with the painted image. The advantage to using the original strainer is obvious: David Goist was able to preserve the two paintings in their original context and, by doing so, preserved the scale, format, and aesthetic appeal of the original work.

Disadvantages

It is always unfortunate to replace the original stretcher/strainer with one whose date of manufacture appears inconsistent with that of the painting. The drawback of a new stretcher is loss of information, material, and possibly the loss of original context and function. When it is necessary to replace the original auxiliary support, some intrinsic disadvantages in the designs should be considered. Some conservators hesitate to use the continuous-tension stretcher out of concern for its ability to maintain a tension that is strong, yet gentle enough for paintings, especially older paintings. Even on a lined painting, there is concern that new cracks may form. A disadvantage to using an expansion-bolt stretcher is that the tension of a painting cannot be modified in a single direction. Expansion-bolt stretchers are highly suitable for large format paintings, but for double-sided paintings the stretcher would ideally be made without crossbars. Without cross-members, the structural integrity of the expansion bolt may be compromised for large format works.

The information gathered in this contribution is only a brief summary of articles already published on the subject of double-sided paintings. It is recommended that the reader refer directly to all original texts when considering a treatment to stretch or restretch a double-sided painting.

Rikke Foulke

Submitted September 2006

Shaped Stretchers

Guidelines for the organization and fabrication of shaped (nonrectangular) stretchers are difficult to establish because of the variety of possible shapes and the particular conditions of each case. A discussion of some of the factors involved may, however, be useful.

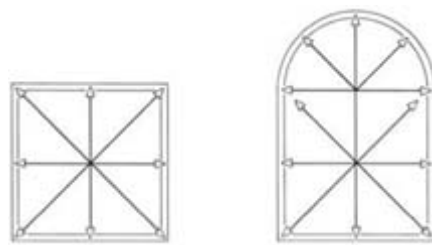


FIGURE 56 Vector lines indicating proportional expansion of a perimeter shape from single and multiple points.



FIGURE 57a Shaped stretcher bar made by butt joining three blocks to one single straight board and then trimming the excess to achieve the final shape (shown with wood grain indicated).



FIGURE 57b More pronounced curves should not be made by parallel to grain stacking. Larger curves should be fabricated by orienting segments so that the grain more or less follows the perimeter of the side. Joints between the segments can either be fixed (with false tenons, for example) or expandable, depending on the length of the segment and/or the stiffness of the canvas.

Stretcher design, in general, must be resolved in terms of the *proportional* expansion of a perimeter shape from a theoretical center point or points (fig. 56). While this statement holds true in theory for the simplest rectangle or the most complex shaped canvas, compromises must be made in the actual fabrication of any stretcher. All stretchers consist of some combination of rigid sections and expandable joints. The rigid sections interrupt the uniform proportional expansion of the perimeter. In order to effect true proportional expansion, expandable joints would, at the very least, need to be placed between every tack or staple on the entire tacking edge.¹ While this solution would obviously be absurd, it serves, by contrast, to illustrate the oversimplification of design inherent in even the simplest traditional rectangular stretchers, which are expandable only at the corners. It is true that rectangular stretchers, the simplest and most common type, achieve a correct proportional expansion of the overall shape, but, technically, each of the tacks would need to slide laterally as the corners are keyed out in order for the *canvas* to effect a true proportional expansion.

It is important to understand this fundamental problem in order to minimize its effect on an eventual stretcher design. The problem becomes more complex in the case of shaped stretchers. Many more joints would be necessary to maintain the proportionally correct perimeter shape. Joint placement is critical to minimizing the distortions caused by the discontinuous expansion of the perimeter. Increasing the number of joints certainly increases the accuracy of the proportional expansion, but it also weakens the overall rigidity of the structure, necessitating a greater number of cross-members and thus increasing the overall weight.

Precision joint construction and increased profile dimensions can reduce the number of cross-members because each component will be less likely to flex after the stretching of the canvas and the keying out of the joints. Stretcher profile thickness, though, can sometimes be a limiting factor; for instance, when a period frame with a very shallow rabbet exists for the picture.

Generally, each curved or otherwise shaped side of a stretcher should be organized so that the grain of the wood most closely follows the overall length of that side. Sometimes, lengths of boards can be butt-joined and glued side by side, parallel to the grain, to account for gradual curves in the perimeter and then be trimmed to fit the final shape (fig. 57a). When the curves are too sharp or abrupt, however, they must be pieced together in sections so that the grain direction more or less follows the perimeter line of that side (fig. 57b). This is necessary because if the grain were to remain parallel, it would tend to split easily as the curve approaches 90° from its starting point. That is, wood is weakest when the grain is oriented across the board width rather than along its length. The joints between these pieces can be fixed or expandable, depending on the length of each segment and/or the stiffness of the canvas.

Smaller notches in the perimeter that were necessary, for example, to accommodate capitals or other architectural details in site-specific settings usually need not be considered in terms of perimeter expansion. These areas can remain as fixed shapes notched out of the stretcher profile with some additional, parallel-to-grain blocking for strength (figs. 58a, 58b).

The problem of distortions caused by the discontinuous expansion of the perimeter in conventional rectangular stretchers has traditionally been partially compensated for by the method in which a canvas is stretched onto the stretcher, i.e., by beginning with straight pulls at the centers of each side and following with subsequent pulls angled slightly toward the corners (see section 6 in *Stretchers and Strainers: Treatment Variations*). Other factors to keep in mind when planning the design and joint distribution of any stretcher include the brittleness or fragility of the original canvas and the rigidity of the lining, both of which limit the amount of tensioning possible. These factors could affect the type and number of joints as well as the number and placement of cross-members.



FIGURE 58a Lorenzo Lotto, *Saint Nicholas in Glory with Saints John the Baptist and Lucy* (335cm. x 188cm.). Santa Maria dei Carmini, Venice.

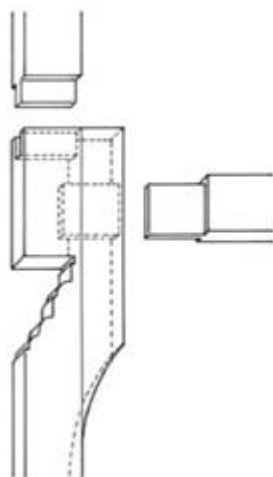


FIGURE 58b Hypothetical example showing notching of a stretcher bar to accommodate a capital; parallel to grain block added to increase strength; joint construction and distribution.



FIGURE 59 Giambattista Tiepolo, *The Triumph of Marius* (558.8cm. x 326.7cm.)(left) and *The Battle of Vercellae* (411.5cm. x 376.9cm.) in the grand entrance gallery to the European paintings collection at The Metropolitan Museum of Art.

One case example:

In conjunction with the renovation of the grand entrance gallery to the European paintings collection at The Metropolitan Museum of Art in 1995, a decision was made to return the three large history paintings by Tiepolo exhibited there to their original 18th-century shapes (fig. 59). The three paintings, the largest of which measures almost 18 1/2 feet in height, had been altered in the past, probably for expedience, by a combination of additions and cropping to form simple rectangles. The reconfiguration, naturally, would require new, shaped stretchers and frames.

The first step in the design of the stretchers was to select the type of corner joint. Although the perimeter of the pictures was irregularly shaped, each consisted of four primary, right-angled corners with two straight vertical sides and two shaped horizontal sides. Mitered or partially mitered joints (see section 2.1) tend to flex more than full mortise and tenon joints, particularly on stretcher bars of longer lengths, because of the greater tendency of the stretched canvas to torque the corner out of plane. Full mortise and tenon joints are considerably stronger but are often avoided because they create a step on the outer edge of the tenon side of the joint when they are keyed out, rather than opening at the corner as do miter joints.

One type of mortise and tenon joint, common in Italy but little known elsewhere, neatly resolves this problem. By adding a strip on the outer edge of the entire perimeter, the expansion can be carried to the corner. This strip is taller than the stock of the stretcher and beveled on its inner edge, effectively distancing the canvas from the stretcher bar. There is no need to bevel the inner face of the entire profile (as is common in most stretcher designs). By keeping the main part of the profile rectangular, the joints are not only easier to cut, but also the interlocking elements can be correspondingly thicker, producing a stronger joint (figs. 60a, 60b). This joint uses two opposing keys, but they are significantly different from the thin ones used in so-called French double key stretchers. One key is exactly as thick as the rectangular stock of the stretcher and is forked to fit around the tenon. The other is exactly the thickness of the tenon and passes through the fork of the first key. The keys are considerably thicker and stronger and, since both of them are effectively centered, they protect better against the torquing of the joint as it is keyed out. Because of the size of the Tiepolo canvases, this joint seemed to be an ideal choice.

The wood selected for the main body of the stretchers is Sitka spruce (*Picea sitchensis*) in near radial section. This wood is strong, resilient, fairly lightweight (specific gravity 0.40), and grows very straight and tall. (It is not uncommon to find perfectly straight-grained, knot-free boards in excess of 25 feet in length). The beveled perimeter strip, instead, is made of basswood (*Tilia americana*), which accepts tacks or staples better than the spruce, which has more of a tendency to split when nails are driven into thinner stock. The keys and the small crossgrain header inside the mortise should be made of a hardwood. Beech (*Fagus grandifolia*) or White Oak (*Quercus alba*) are good choices. In this case, the oak available happened to be of higher quality.

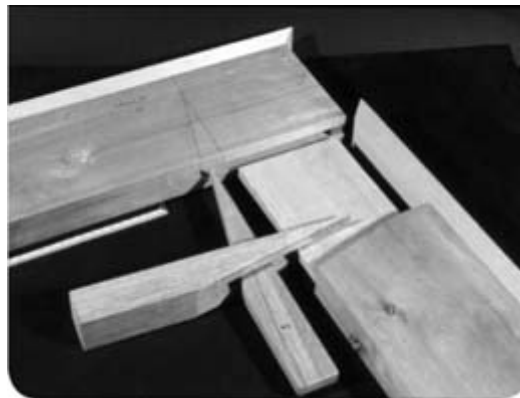


FIGURE 60a Full scale mock up of the corner joint for the stretchers of the three Tiepolo paintings, fully open. Pencil lines on the mortise indicate the angled cut that accommodates the single key. The tenon has the same angled cut, visible on the exterior, for the forked key.

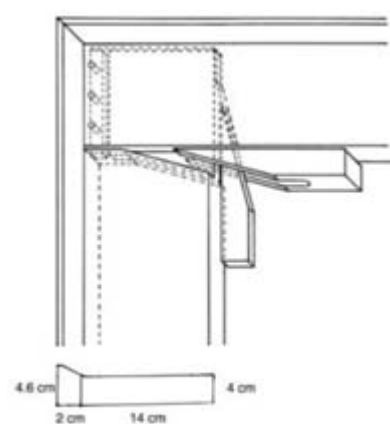


FIGURE 60b Axonometric rendering of the corner joint with profile dimensions at the bottom.

Very precise joints can really only be made on a shaper with dado cutters. It is also possible to cut the joints with a good band saw, but there is a substantial drop in accuracy. The mortises are generally cut first after dividing the profile thickness into equal thirds. The first pass on the shaper cuts a straight mortise. A second, inclined or angled pass is then necessary to accommodate the key, but a segment of the first pass is left intact—about 20 percent of the total width of the stretcher bar (figs. 60a, 60b). This is done for two reasons: first, the short, straight section helps keep the joints square when closed, for example, during stretching; second, it establishes the amount that the stretcher can be keyed out. As the key is tapped in, the corresponding side is pushed outward—but only until the tip of the key hits the perimeter strip, thus limiting the amount of expansion. In this case, as the key travels three centimeters, the stretcher bar moves one centimeter. The angle of the second pass is 12 1/2 degrees. If the angle is too great, the key will tend to loosen; if it is too acute, the key has to travel too far to effect a significant amount of expansion.

Finally, a small header is placed across the open end of the mortise. It should be doweled and glued in place to keep the two ends of the mortise from splaying because of the torque caused by the tensioned canvas. The tenons are then cut in much the same way. One or two passes are required to cut a straight tenon and one or two more, inclined, to accommodate the key on either side of the tenon.² A portion of the tenon (toward the outside of the stretcher) must then be cut away to accommodate the cross-grain header at the end of the mortise and to set the maximum amount of expansion. In other words, the width of stock minus the width of the header, minus the maximum desired amount of expansion, equals the width of the tenon.

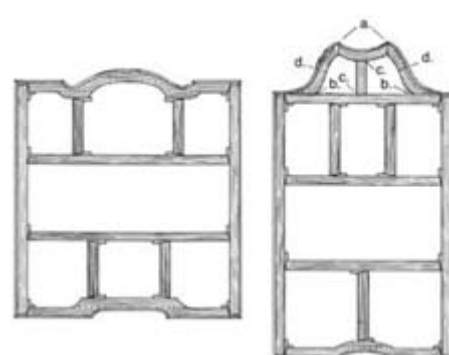


FIGURE 61 Schematic drawing of the two stretchers (of the three Tiepolo paintings, two have identical stretchers) showing the orientation of the wood grain and position of the keys. Joints at *a*, *b*, and *c* are all rigidly fixed. The double-lined canvas was considered too stiff to necessitate expandable joints in this area. Had the canvas been more flexible, keyable mortise and tenon joints would likely have been added at points *d*. Points *a* and *b* would have remained rigidly fixed, but strut *c* would have become keyable.



FIGURE 62 Applying the laminated basswood edge strip to the exterior of a stretcher bar. Adhesive is spread between each of the laminates, which are then stacked and held together with jigs (visible in foreground with small clamp). These jigs permit the composite strip to be easily bent around the curves without shifting and to be nailed in place.

The methodology of the corner joint construction also applies to the organization of any cross-members. Naturally, the overall size of the stretcher and the dimensions of the stretcher bar stock will determine the number of crossbars necessary, but this type of construction generally requires fewer cross-members. In this case, the stock measured 14 cm x 4 cm (5 1/2 in. x 1 1/2 in.)—exclusive of the 2 cm-wide perimeter strip—and the long sides averaged approximately 4 meters (13 ft.) in length. Each stretcher required only two cross-members and a few struts. Conventional stretcher designs often organize the cross-members in such a way that they cross each other at right angles using a lap joint at the intersection. These cross-members are thin to begin with (because they can only be as thick as the tapered inner edge of the beveled profile). Notching each cross-member to construct the lap joint interrupts the continuity of the cell chains, effectively weakening the stock by half. In the Italian design, the rectangular section of the main part of the stock allows for thicker and consequently more rigid cross-members. Lap joints are never used; any intersection with an opposing element is mortised, leaving uninterrupted mass on both faces of the main cross-members, thereby maintaining most of their overall rigidity. Short struts that bridge between the outermost cross-members and the perimeter are generally the only additional support necessary. These struts offer additional resistance against the perimeter lifting out of plane as the canvas is stretched. They also assist in the keying out process. Struts between cross-members are generally unnecessary because the cross-members are fixed in one direction. Tenons can slide in and out of the mortise to expand the perimeter, but they cannot move laterally. The full tenons completely occupy the mortises and are not cut away to allow two-direction expansion as they are in the corner joints. This makes a stronger, tighter joint and provides a fixed point for the struts to push off from. All cross-members and struts, then, have tenons on both ends. All interior mortises are cut to a depth equal to two-thirds the width of the stretcher bar (without the raised perimeter strip).

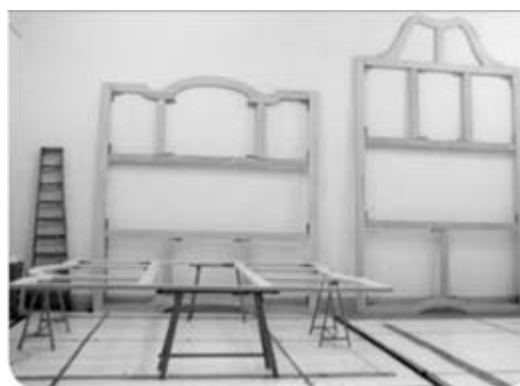


FIGURE 63 The three completed stretchers before application of raised edging strips.

Finally, in this case, all of the irregularly shaped sides (the horizontals) were made without internal expandable joints. The three canvases all had old double paste linings and were judged to be too rigid and inflexible to require additional expansion. The only expandable joints on each stretcher, then, were the four right-angle corner joints and the ends of the cross-members and struts (see fig. 61 for the distribution of the joints and the orientation of the wood grain on the shaped sides). The basswood perimeter strip, which was added last (fig. 63), generally constitutes approximately one-eighth the total width of the stretcher bar. In this case, the overall width measured 16 centimeters—14 for the main part and 2 for the perimeter strip. The beveled edge of the perimeter strip was made by passing rectangular stock through an inclined jig laid on the bed of a thickness planer. The curved sections were made using stacked laminations. Six lengths were first stacked together without glue to make up the two centimeters thickness, and then the same jig for the thickness planer was used to produce the bevel. An adhesive with a long curing time (Ciba-Geigy Araldite® 2011) was then spread between all the layers at once. They were then stacked and held together with several small clamping jigs that kept them in alignment while also permitting them to slide laterally to allow the composite to be easily bent around the curves without shifting and to be nailed in place until the adhesive cured (fig. 62).

Author's note: The author would like to thank Ciro Castelli of the Opificio delle Pietre Dure in Florence for his invaluable assistance with this article.

George Bisacca

Submitted April 2000

Folding Stretchers



FIGURE 64 19th-century German two-point folding stretcher

Historical Review

Although it is often thought that folding stretchers are a contemporary phenomenon that developed out of the need to facilitate the transport of oversized modern paintings, there is evidence that folding stretchers existed as early as 1735.

In her article, “The Restoration of Paintings in the Spanish Collections, 1734– 1820,” Zahira Veliz traces the conservation of the collection of paintings in the Royal Alcazar palace in Madrid that took place after the Christmas Eve fire of 1734 (Veliz 1998). Jean Ranc, an artist of the court, recommends a plan of action to begin the process of removing the paintings from the court and provides initial thoughts on the process of planning the restoration of the collection. On January 18, 1735, Ranc writes, “The stretchers for the very large paintings must be hinged in two parts, so that it will be possible to fold them and to transport them without having to roll them” (Veliz 1998, 45). In this passage, Ranc recommends the use of a folding stretcher, and although it has not been confirmed that they were ever actually used, it is clear that they existed.

Examples of folding stretchers are often seen on full-length portraits in Great Britain. Folding stretchers have been noted on British portraits of the 17th and 18th centuries, but these appear to be 19th-century replacement stretchers (Owen-Hughes via Fisher 1999).

A patent design for a 19th-century German folding stretcher with two folding points was also brought to my attention by Hubert von Sonnenburg (von Sonnenburg via Bockrath 1999) (fig. 64). No existing examples for the use of this stretcher have come to my attention.

In America, the artist John Vanderlyn wrote to Leonard Jarvis on October 27, 1817 (Zucker 1995):

...Your picture of Napoleon may do well in Baltimore & perhaps also in Washington— Philadelphia I question...ultimately Charleston and New Orleans would do well to send it to but there is vast trouble in moving it about & I would advise you to have the straining frames made so as to loosen in the middle & by a curve to fold in two so as not to be obliged to take it from its strainer at each time you move it which is both troublesome & very injurious to the canvas all about its edge. I have seen this done, and would have it done to this were the picture mine, it might then be put in a case (in its strainer) of a moderate size (half the size of the picture) I will undertake to have it done if you decided so... [letter from collection of Williams College, loaned by Thomas D. Williams (1971)].

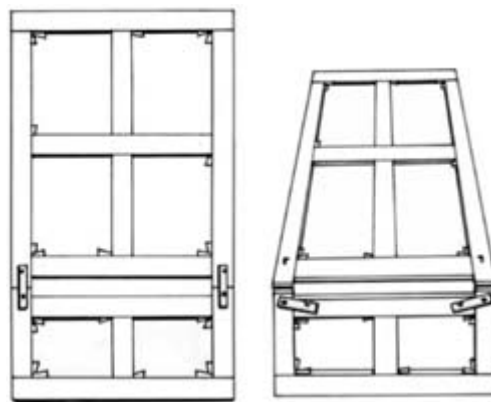


FIGURE 65 19th-century English folding stretcher

Vanderlyn's recommendations and theory for the use of a folding stretcher foreshadow the rationale behind its resurgence in the late 20th century. That is, it was more convenient for the transport of oversized paintings in that it eliminated the need to remove a painting from its stretcher, roll, and restretch after every venue that it traveled.

Materials and Fabrication

Folding stretchers are constructed of materials similar to those used in any wood stretcher. The joint at which the stretcher is folded is usually stabilized with a flat metal plate that is screwed to the wood stretcher frame. The British 19th-century examples observed have had a wood batten secured over the folding joint of the stretcher (Buckley 1990, Owen-Hughes 1999) (fig. 65). The battens were attached with wing nuts. The battens did create a level difference on the back of the stretcher, but as the size of a full-length portrait is often at least eight feet in height, the level difference did not interfere with the hanging.

Although less common, it is also possible to have a three-part folding stretcher with two folding points. An advantage with this system is that the painting is folded outward in three parts (Liu 1999, Swope 1999).

Conservation Use

An increased use and popularity of the folding stretcher emerged in the 1960s through 1970s, but by the 1980s conservators were well aware of the deleterious effects that folding stretchers had on the painted surfaces and the canvases that they were supporting (Domergue 1999). Mechanical cracking and cleavage of the ground and paint layers at the point of folding is often noted. Tears are also commonly noted along the tacking edges of paintings; the tears are created by the wear on the canvas that the process of folding causes. Conservators have noted that a lack of sensitivity on the part of untrained technicians during restretching has also caused the canvas to be stretched out of shape at the center if the canvas has been restretched many times; in addition, a scalloped cracking pattern can also be noted that is induced by the restretching process (Potoff 1999). Damage caused by art handlers inexperienced in the use of a folding stretcher was also noted by conservators.

Conservators of modern paintings express a decided dislike of folding stretchers and view them as a type of inherent vice. These stretchers are often accepted as part of the history of the painting, but conservators try to devise methods to reduce the damage that a folding stretcher can cause. Padding the tube and using as large a dimension tube as the stretcher will accept were both noted as ways to alleviate the compressed stress caused by folding a painted layer in on itself (Potoff 1999).

Continued use of a folding stretcher is often against the advisement of a conservator. However, the economics of purchasing a new stretcher, a rolling tube, and the cost of labor to roll and restretch a painting may be seen as cost prohibitive to some owners of paintings on a folding stretcher. In addition, the transportation and crating costs for a large painting decrease when it is shipped in a smaller folded format.

Artist/Contemporary Use

Folding stretchers were developed for the oversized paintings of the 1950s as a way to expedite transport of these paintings from the artist's studio to the gallery (Potoff 1999). Doors, stairwells, and elevators in modern buildings could not accommodate the size of paintings being created. It otherwise would be necessary to remove paintings from stretchers, roll them, and then restretch them on arrival at their destination. Generally, paintings that are over 10 feet in one direction are often considered to be candidates for a folding stretcher.

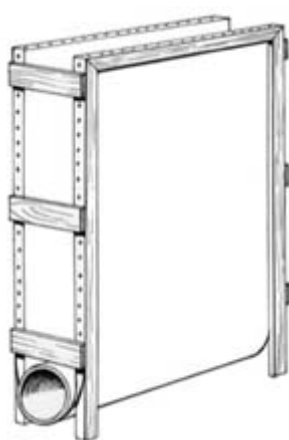


FIGURE 66 Contemporary folding stretcher with tube

James Lebron, noted for developing the expansion bolt stretcher (see section 2.2), is also credited for developing the folding stretcher for New York City artists in the mid-20th century (Lodge 1991). Folding stretchers can be found on paintings by such artists as Morris Louis, Helen Frankenthaler, Kenneth Noland, and Anselm Kiefer (Albano 1999). The choice and use of a folding stretcher were often the preferences of the artist and/or gallery. Some contemporary artists, such as Matthew Ritchie, prefer that their paintings be rolled for transport (Albano 1999).

Special Considerations

The process of folding a painting is done with a minimum of two people working in unison (Lodge 1991, Potoff 1999). Three to four people are recommended because a painting on a folding stretcher is often large in size and unwieldy, creating an art-handling challenge under any circumstance. One method of removing the hardware for the folding joint of the stretcher is to place the painting face up across two-by-fours resting on saw horses (to have access to both the recto and verso of the painting). The painting is detached from the stretcher at the center tacking edges (the point at which the painting will be folded); this will be approximately one foot in length at minimum. The painting canvas at the center will be loose after detachment. To add tension to the canvas so that it doesn't crease, a tube, which can be padded, is placed against the folded canvas (fig. 66). The tube reduces, but doesn't eliminate, the potential for cracking. The two vertical sides of the stretcher are folded together so that the painted surface faces inward and the sides are parallel to each other. The tension of the tube is kept by attaching boards to the outer edges of the stretcher, thus restraining it from movement. The detached portion of the canvas remains vulnerable at the outside of the fold.

Author's note: I wish to thank the following for their discussions regarding contemporary and historical use of the folding stretcher, without which I could not have compiled this entry: Al Albano, Denise Domergue, Sarah Fisher, Harriet Owen-Hughes, Larry Keith, Simon Liu, Robert Lodge, Mary McGinn, Leni Potoff, Mary Sebera, Hubert von Sonnenburg, James Swope, Zahira Veliz, and Joyce Zucker.

Barbara A. Buckley

Submitted August 2006

Backing Inserts and Stretcher Linings

Introduction

When a conservator is assessing the structural relationship between a canvas support and its stretcher/strainer, concerns may arise about the deflection of the painting on its auxiliary support. These concerns arise whether a painting must travel great distances or be moved across the room. Casual handling should not be taken lightly, as damage more often occurs as a result of handling than during vehicular transportation (Costain 1991, 20). When the deflection of a moving canvas is severe, or the bevel on a stretcher/strainer is not adequate, the canvas can slap against the crossbars creating stretcher bar creases and cracking. While research has suggested that a canvas under “normal tension” is not at risk of damage due to vibrations alone, what are considered the secondary effects of the vibration—such as the slap of the canvas against the stretcher bars—can cause damage to a painting (Marcon 1991, 111). The situation is complex and, in addition to controlling the factors of humidity and temperature, the age of a paint layer, its fragility and condition, the quality of the stretcher/ strainer, and the tension it provides the canvas must all be taken into account when assessing possible risk. As such, precautions are often taken to minimize the movement caused by vibration. These precautions can also reduce the possibility of damage caused by an impact.

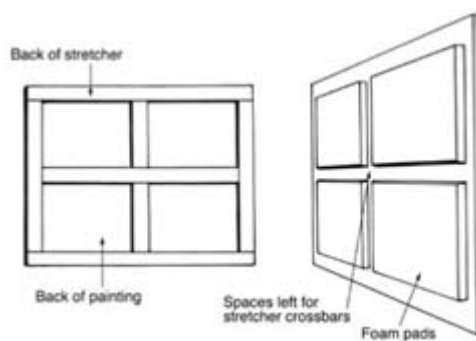


FIGURE 67 Backing insert before securing to stretcher

In taking steps to minimize this movement, unless there are extenuating circumstances, it is often undesirable to remove the painting from its stretcher (see sections 1.1 and 1.2 in *Stretchers and Strainers: Factors to Consider*). Both the backing insert and the stretcher lining were developed to address these constraints. In discussions with numerous conservators it became clear that there are many variations of these two techniques, particularly the backing insert. Despite the wide variety of methods and choices of materials, the goals are the same—to reduce the deflection and vibration of the canvas. Some methods have been subjected to scientific testing while others have been intuitively developed in individual studios. Rather than catalog the myriad varieties of backing inserts and stretcher linings, this section will focus on the general form that these two techniques take and the decision-making processes that led to the choice of materials and their application.

The Backing Insert

The backing insert seeks to create a continuous surface behind the canvas so that the canvas cannot deflect backwards. The backing insert attempts to fill the voids created by the structure of the stretcher/strainer (fig. 67). The backing insert has the advantage of being easily applied and easily reversed without requiring removal of the canvas from its stretcher/strainer. As the name implies, the materials used to fill the voids in the stretcher are typically attached to or supported by the backing board. Materials employed for inserts have included polyester urethane foams, Ethafoam®, Volara®, polyester battings, Coroplast®, Gatorfoam®, Fome-Cor®, acid-free blue board, mat board, Tycore® honeycomb paper boards, and various combinations of these materials. Means of attaching the inserts to the backing board have included hot glues, cold contact adhesives, double-sided tapes, adhesive sheets, sewing, and, in the case of some of the lighter-weight inserts, the restraining support of the rigid backing board alone. For all backing inserts, attached or not, the backing board itself needs to be fairly rigid and in plane. If the backing board becomes warped, as was noted in one case of a backing insert constructed of Ethafoam® mounted to Fome-Cor®, the insert material can press forward into the picture and put stress on the canvas and design layers.

As needed, single or multiple layers of the material chosen for the inserts are cut to custom fit each void in the stretcher/strainer, with care taken to create cutouts for the keys. The goal is to place the insert into the voids so that the insert is just touching the back of the canvas or just shy of this. Care must be given not to allow the insert to push the canvas forward as this will put undue stress on the canvas and paint layers and give the painting an overstuffed pillow quality. Typically, backing inserts are installed with the painting upright so that judgments can be made about the placement of the inserts while observing the face of the painting.

The choice of material depends on several factors, including the stability of the material, the desired rigidity or softness of the insert and its ability to dampen vibration, the overall weight of the combined painting and insert structure, its implications for safe handling, and the length of time that the backing insert will be in place. Each material has its benefits and shortcomings, and the particulars of each painting will dictate which materials are appropriate. The following insights were gained from discussions with various conservators:

- Grey polyester urethane foam is often used as a temporary insert that will remain in place only when a painting is in transit or on loan. It is easy to cut and therefore easy to work with, relatively lightweight, and a good vibration dampener. It is not as chemically stable as other materials and thus should not be left in place as a permanent support. Polyester urethane foam is a material that has been used on small paintings without attachment to the backing board. In some cases, it can be restrained from moving forward and slipping between the canvas and the crossbars by inserting running stitches of monofilament thread through the foam and stapling the monofilament to the stretcher through a layer of blotter paper.
- Polyethylene foams like Ethafoam® or Volara® have good aging characteristics and are also good at dampening shock and vibration. Both of these polyethylene foams can add considerable weight to the overall package and, as such, can make very large paintings more difficult to handle. Ethafoam® comes in greater thicknesses than Volara®, eliminating the need to laminate layers of foam. Due to its rougher open cell structure, conservators often use an interleaf layer of fabric to give the Ethafoam® a more desirable surface. Layers of Volara® foam may need to be laminated together for very deep stretchers, but its surface is very smooth and soft.
- Polyester battings, manufactured without resins, are stable and very lightweight and, as such, can be excellent for large-scale paintings. Many conservators rely on the backing board and the nap bond between the batting and the canvas to hold the insert in place. Others fear that the batting will sag with time and prefer to stitch it to the backing board or to add twill tape straps. These straps are either sewn to the batting and then stapled to the stretcher or are merely stapled across the openings in the stretcher to apply another layer of restraining support. Likewise, in the use of two layers of batting, the nap bond between the two lightweight layers has been found to keep the layers from shifting. Layers of batting can easily be split for a variety of thicknesses, and layers can easily pass in front of the crossbars to help form a more continuous support behind the canvas. While splitting the batting may result in some unevenness across the sheet, these minor variations tend to flatten out as the batting is compressible. As a result of its easy compressibility, though, it may not be an appropriate cushioning material for paintings with very heavy design layers. Furthermore, one has to be extra careful not to compact the batting while filling the void as this can lead to the overstuffed painting look.
- Rigid boards, such as the Coroplast®, acid free Fome-Cor®, blue board, sealed Gatorfoam® and Tycore®, have all been used to create either solid laminate supports or lighter versions in the form of hollow box-like structures. Either can act much like a panel stretcher, providing good support to a heavy painting. Both types of construction can be labor intensive as they may require the gluing together of several layers, but if the materials are chosen carefully, these structures can be considered long-term supports. Some of these rigid inserts are not attached to the backing board but rather given a lip or tabs at the outside edges to keep them in plane with the back of the crossbars while the backing board prevents them from falling out (fig. 68).
- In order to attain a more complete overall support, rigid boards of various types have also been used to create systems that seek to mimic the panel stretcher without requiring removal of the painting from its stretcher. In some cases, one edge of the painting is released in order to slide a panel into place that will support all but the outermost edge of the image area, where the inserted panel comes in contact with the bevel of the stretcher (fig. 69). More complex, but more in keeping with the desire to not release the painting from its stretcher at all, are systems where

a panel is cut to just shy of the actual dimensions of the painting and then cut apart into smaller sections so that they can be slid through the openings in the crossbars. These sections are slid right up into the space created by the bevel on the outer members and then rejoined to once again create a “solid” panel. Examples were found where the joins coincided with the crossbars and others where that was not the case. Both the rejoined and the solid panel supports are typically kept in plane and just shy of or lightly touching the back of the canvas by being attached to and supported by the crossbars with some type of spacer (fig. 70). In other instances, where the panels have enough depth, they are secured directly into the backing board (figs. 71a, 71b). In the systems of rejoined panels, conservators often pare away the core of their panels at the bevel of the outside members and, in some instances, at the crossbars in order to be left with a flap of the paper laminate that can pass over these junctures (fig. 72). This was considered important in providing a more continuous surface as well as a softer edge to the board. This softer edge was considered an important step by some to reduce the potential of creating new stresses in the painting if it came into contact with a hard edge.

- In the creation of inserts, combinations of these materials were also found to be very common. Volara® is often used as the last layer in a rigid laminate structure to give some cushioning or as a final layer to a polyester urethane insert to put a more stable material close to the canvas. Rigid foams or boards likewise have been used in combination with batting to reduce the depth of the stretcher/strainer void and diminish fears that the batting might sag or compress excessively. The use of a fabric to cover Ethafoam® has already been cited. Fabric has also been used to encase batting to create “pillow” inserts that were then selectively compressed with needle and thread to accommodate the reverse of a painting that was not flat. Mat board has been used as a laminate with other rigid boards for its archival and surface qualities. Attempts have also been made to modify the surface of some inserts by facing them with linen or flannel.

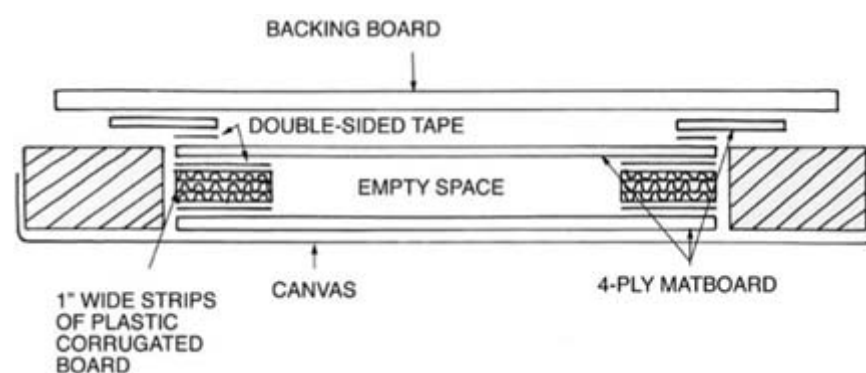


FIGURE 68 Rigid insert attached to backing board

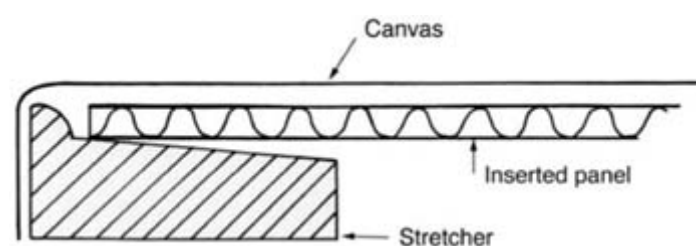


FIGURE 69 Rigid insert: unsecured

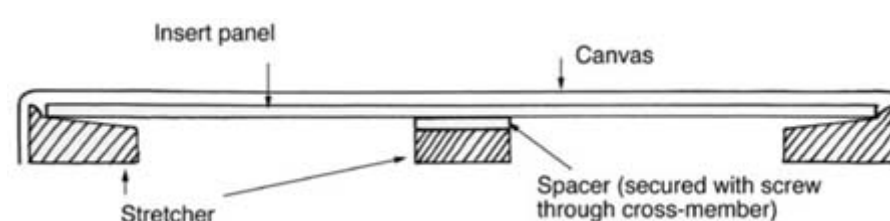


FIGURE 70 Rigid insert: sections secured through cross-member

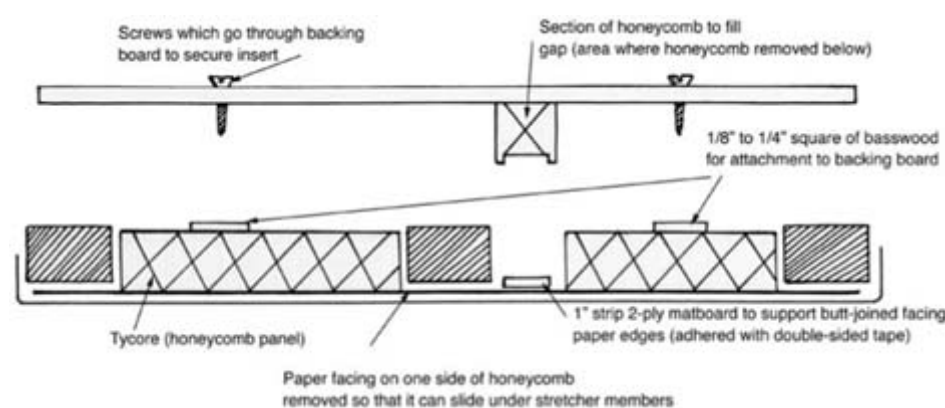


FIGURE 71a Honeycomb panel insert secured to backing board

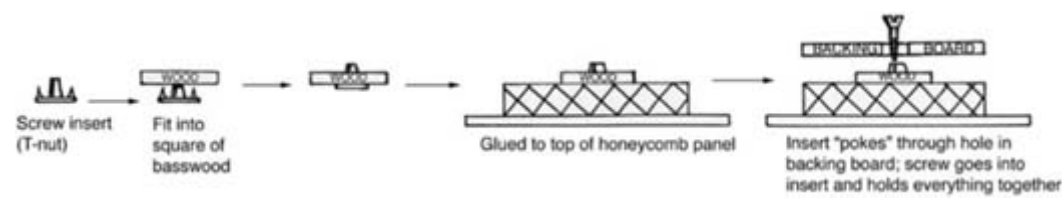


FIGURE 71b Insert secured to backing board

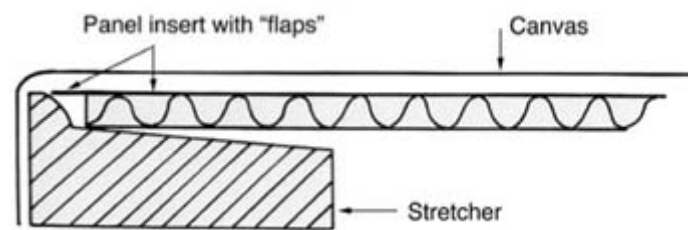


FIGURE 72 Rigid insert with pared edge

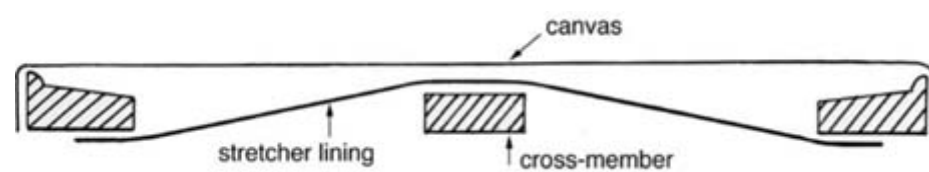


FIGURE 73a Stretcher lining

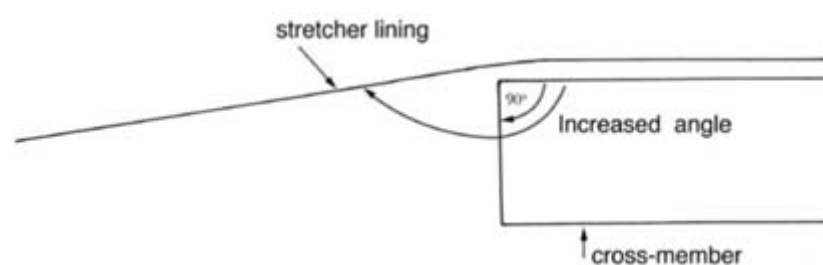


FIGURE 73b A stretcher lining reduces risk of stretcher bar creases from cross-member

Methods and materials used to create inserts vary considerably, but there are overriding principles that guide their design and use. When assessing the use of or type of insert for a painting, the following questions are helpful to ask:

- How long will the insert be in place?
- What is the long-term stability of the materials being used?
- How heavy is the design layer of the painting?
- How much rigidity will be needed to support that design layer?
- How much weight will the inserts add to the overall structure and how will that affect safe handling?

As in most things in life, the fewer elements to your solution the fewer chances there are for unforeseen problems. It is best to keep the construction of your insert as simple as possible while providing as much and as complete a support as possible.

Stretcher Lining (crossbar or cami-linings)

The design for the stretcher lining was first presented in 1989 by Peter Booth in *The Conservator*. Developed by Mr. Booth at the Tate Gallery, the stretcher lining was originally called the camilining, for they reminded Booth of the “cami-knickers” or undergarments worn by the dancers in the Toulouse Lautrec paintings that he was studying at the time. In the United States, the term “cami-lining” is still fairly common, but the term “stretcher lining” has gained in usage and is preferred by many. It should be noted that Mr. Booth himself prefers the term “crossbar lining,” as he feels that stretcher lining is too vague (Booth 2000).

The stretcher lining was envisioned to address the problems of the canvas hitting against the crossbars. Passing a fabric behind the crossbars and securing it tautly to the outer members mitigates the sharp edges of the crossbars, thus reducing the likelihood of stretcher bar creases. The cami-lining increases the 90-degree angle of relationship between the back and the sides of the crossbar, moving it closer to 180 degrees (figs. 73a, 73b). With this increase in angle, there is a reduced risk of forming stretcher bar creases. Subsequent research has shown that if a stretcher lining is adequately taut and stiff it will, like the backing board, reduce vibration in a canvas. The physics of this are discussed by Timothy Green in *Art in Transit* (Green 1991, 62).

To create a stretcher lining, a piece of fabric is cut slightly larger than the dimensions of a backing board. The fabric is folded, passed underneath the crossbars, unfolded, pulled tight, and then secured onto the reverse of the stretcher's outer members (fig. 74). In order to make this possible, cutouts need to be made in the edge of the fabric wherever a crossbar joins the outer members. Often the registration of these cutouts is

facilitated by first laying out the fabric across the back of the stretcher, pinning it to the outer members, and marking the location of these junctures. Cutouts should be made in the fabric at the locations of the keys to maintain access to them. Once the fabric is in place, the edges are tensioned and secured to the reverse of the stretcher with staples.

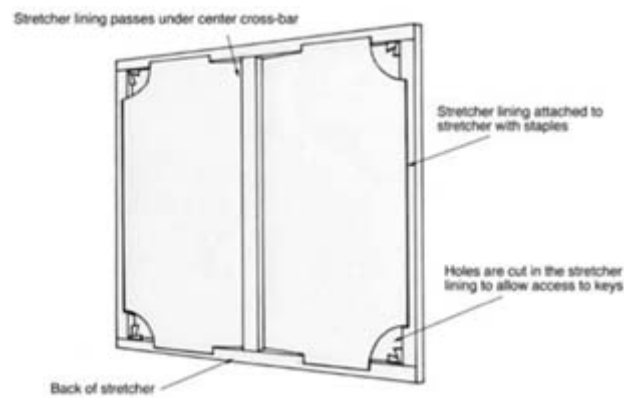


FIGURE 74 Stretcher lining

While the stretcher lining was envisioned as being executed in a synthetic material, it was found that many conservators were doing stretcher linings with muslin or linen. None of those questioned had noted problems arising from the lack of dimensional stability. Most had washed the natural fiber fabrics before they used them, and some had resized them. Often this choice was motivated by the size of the paintings in question and the lack of readily available and affordable large-scale synthetic fabrics. In one case, large paintings were installed in a building that was known to have humidity problems. It was hoped that the muslin stretcher linings would act as buffers to humidity changes. In another, a muslin stretcher lining was chosen for its color, along with its large dimensions. In this case, the weave of the original unprimed and exposed cotton duck canvas had apparently opened up with age, allowing the dark form of its heavy-weight stretcher to show through to the face of the painting. Large dimensions in synthetic fabrics are obtained by creating joins with stitching or adhesives.

Staples remained the fastener of choice, but there were a few examples where Velcro® had been used in order to provide easier access to the reverse of the painting.

While the stretcher lining has for advantages its extreme lightweight nature and its ease of execution, it does little to protect the canvas from contact with the outer members of the stretcher/strainer, if that is a problem. For this reason, while conservators were found to be using more backing inserts than stretcher linings, the stretcher lining was still found to be very effective and in some cases more practical.

Author's note: Several conservators were consulted during the researching of this article, including Anny Aviram, Peter Booth, Brad Epley, Pia Gottschaller, Paul Haner, Harriet Irgang, Irene Konefal, Jay Krueger, Virginia Rasmussen, Merv Richard, and Chris Stavroudis.

Heather Galloway

Submitted September 2004

Temporary Stretchers

Historical Review and Introduction

An historical review of temporary stretchers sounds like an impossible task as the objects are described as ephemeral by the qualifying term “temporary.” The use of such structures by western European artists is well documented in art works, where artists are depicted painting on canvases stretched to temporary stretchers. Perhaps the most familiar images are those associated with Rembrandt's studio, where artists are seen working on canvases stretched to temporary frames with cords (von Sonnenberg 1995, 71). Other examples are found in paintings by J. M. Molenaar and P. Codde, while examples of this stretching method are documented in collections in the Netherlands (Marijnissen 1985, 77). In American collections, some images of artists working on temporary stretchers where canvases are tacked or stretched include Hans Burgkmair's woodblock print, *The Emperor Maximilian in a Painter's Studio* (New York, Pierpont Morgan Library, PML 4056) c. 1473 and Jan Steen's *The Drawing Lesson* (Los Angeles, J. Paul Getty Museum, 83.PB.388) painted c. 1665 (Walsh 1996).

The use of temporary stretchers by painting conservators has been adopted from the artist's use of the same structure. Making and using a temporary stretcher is a creative practice that is not often documented. For this reason, the information used to compile this chapter relies heavily on two surveys. The first was compiled in 1975 by Steven Vanderhoff, then a student of Joyce Hill Stoner at The Virginia Commonwealth University, in Richmond, Virginia. Mr. Vanderhoff's survey was compiled in a paper titled, “A Survey of Stretchers Currently Used for Stretching Lining Canvases and Lined Paintings.” A second survey was conducted at the 2001 American Institute for Conservation Annual Meeting with the intention of updating information that was acquired by Vanderhoff in the mid-1970s.

In survey responses from 2001, respondents did not always make the distinction between the use of stretchers or strainers. For the most part, however, it seems that respondents preferred to use stretchers because of the “keyability.” In the text below, the term “stretcher” will be used for brevity in lieu of both stretcher and strainer. Where necessary, the distinction will be made between the two structures.

Methods of Tensioning the Original Canvas

Stretchers and strainers are often used to allow for the temporary tensioning of paintings during the course of conservation treatment. The tensioning of a painting on a temporary stretcher may be done by relaxing an existing tacking margin to be in plane with the surface of the painting. In some cases this is not possible, and one must accommodate the angle of the tacking edge. In the 1999 AIC Paintings Specialty Group Postprints, Robert Proctor published his tips for “Fixing Paintings in Work Stretchers without Flattening the Tacking Margin” (reprinted in section 7 in *Stretchers and Strainers: Treatment Variations*).

Dutch Method

In the 2001 survey, a number of conservators mentioned using the “Dutch Method” for temporary stretching. The Dutch Method refers to the use of Kraft paper and paste for adhering and tensioning the canvas on a stretcher. As a modern variation on the Dutch Method, gummed brown paper tape is now commonly used, either as whole strips that run along the edges of a painting or as smaller strips placed every few inches apart along the tacking edge of a painting. The paper may be attached to the painting with the water-based adhesive on the brown paper tape or with another adhesive. The same tape may be attached to the stretcher in a similar manner. The paper used to stretch the painting is wet during the stretching process; as the paper dries, it contracts, creating tension between the canvas and the attachment to the temporary stretcher.

Alternatively, fabrics such as Pellon® have been used in place of the Kraft paper when the tightening properties of the drying brown paper are not needed.

Use of Clamps for Stretching

Another approach to tensioning the original canvas on a temporary stretcher involves the use of padded clamps connected to fabric strips. Such a method is illustrated in Knut Nicolaus's book *The Restoration of Paintings*, where two flat pieces of wood, joined by a wing nut, are tightened together to clamp onto the tacking edge of a painting. The clamps are positioned so that they are side by side in order to create even tension. The clamps are attached to cloth tape that can be pulled and stapled to the temporary stretcher. This method allows for easy localized adjustments in tension (illustrated in Nicolaus 1998, 102).

Reasons for Using Temporary Stretchers

Working on the Front and Back of the Painting at the Same Time

In the 2001 survey, conservators described using a temporary stretcher for the alternating treatment of the front and back of a painting. The types of conservation treatments specified included interlayer cleavage and tenting paint when the canvas had shrunk. The treatment of cupping paint as well as tear mending may also be more easily facilitated by tensioning a canvas on a temporary stretcher, such as when a canvas may have had a lining removed during treatment, have no tacking edges, or have conservation needs in those areas covered by a secondary support.

Infusion Treatments

The use of a temporary stretcher allows for one to maintain tension of the canvas during an infusion treatment. The temporary stretcher also allows for easy handling of the painting.

Humidification Treatments

The use of a temporary stretcher is commonly used in humidification treatments to maintain tension of the canvas support.

Temporary stretchers or individual members of stretchers have also been used in constructing temporary humidification chambers since their form borders that of a painting. The rectangular form of such a construction fits onto worktables easily. Clamping the stretcher bars in place allows for quick construction of a humidity chamber.

Use of Temporary Stretchers and Strainers for Lining

(a) Preshrinking of natural fiber-made canvases: The use of stretchers to prepare lining canvases allows for one to stretch and restretch natural fiber-made canvases after successive dampening or wetting with water.

(b) Application of adhesives to canvas for loose linings, strip linings, and linings: The temporary stretching of a canvas easily facilitates the application of adhesives in liquid or film form on canvas materials.

Once the canvas has been prepared for lining, it may remain on the stretcher during the lining process or be cut from the temporary stretcher.

(c) Positioning of canvas during lining: Using the temporary stretcher during the lining process allows one to facilitate handling of the picture by positioning the (stretched) lining canvas as desired (maintaining the weave parallel to the original canvas weave) without losing tension. Some conservators reported removing the temporary stretcher before lining on the hot table. Conservators who reported using aqueous adhesives for cold-linings reported using a temporary stretcher throughout the lining process.

Factors to Consider when Using a Temporary Stretcher

- Size of the painting and size of the stretcher
- Method of attachment of the painting to the stretcher
- Planar stability of the stretcher
- Type of tensioning adjustment
- Control of tensioning adjustment
- Finish to the edges of the stretcher so as to facilitate movement of the canvas during stretching

Types of Temporary Stretchers

In the 2001 survey, most conservators reported using commercially available mortise and tenon joined stretchers during treatments. For those conservators who reported making their own temporary stretchers in the survey, half-lap corner joints were described as being the most easy to construct. Custom-made stretchers, described further below, were reportedly used in special cases.

Types of Custom-Made Stretchers

Various types of custom-made stretchers have been described in detail elsewhere in this volume, including the expansion bolt stretcher (see section 2.2), the ICA/spring tension stretcher (see section 2.3), individual bar control (IBC) continuous tension stretcher (see section 2.4.1), shaped stretchers (see section 3.3), and the Starofix continuous tension stretcher (see section 2.4.2). Comments made in the 2001 survey relative to these specific custom-made stretchers are listed below, along with detailed descriptions of temporary stretchers not discussed elsewhere in this chapter.

- *Expansion bolt stretchers*

Some conservators reported preferring to use this type of stretcher. Others commented that the expansion bolt stretcher is not as flexible a working stretcher as using a stretcher or strainer with pushpins. A criticism of the expansion bolt stretcher is that the tensioning adjustment is equal in both directions, prohibiting tension adjustments in only one direction if needed.

- *Stretcher with outside keys*

A working stretcher that has been referred to as the Perry Huston stretcher in the 2001 survey originates from Mr. Huston's time working with James Roth. The stretcher is built with a beveled edge and has keys in all four of the corner joints, which are inserted from the outer edges of the stretcher corner joints (as opposed to the conventional stretcher design for paintings, where keys are inserted from the inside of the corner joint) (fig. 75).

- *Stretcher with outer and inner keyable adjustments*

Similar to the stretcher described above is one reportedly used by Anton J. Konrad in the 1970s (Vanderhoff 1975, 2) (fig. 76). The design used by Konrad included the possibility to key out the stretcher from the inside or outside of the corner joints. The design allows for one to use the same stretcher for preparing a lining canvas and using the same tensioned canvas during lining since tension can be adjusted from the outside, reportedly “saving time and money” (Vanderhoff 1975, 2). These stretchers are not commercially available but can be specially made by a local craftsman.

- *Konrad stretcher with inserted tensioning adjustment*

In response to Vanderhoff's 1975 survey, Anton Konrad supplied a design for a temporary stretcher. The design, illustrated in figure 77, shows a stretcher with raised edges. The tensioning adjustment is a crossbar made from two 3/4- to 1-inch water pipes with steel plates at either end. The pipes are threaded in opposite directions so that through a pipe sleeve a screwdriver can adjust the tension of the crossbar. These stretchers are not commercially available but can be specially made by a local craftsman.

- *Robert Fieux metal design*

A temporary stretcher used in the Paintings Conservation Department of the J. Paul Getty Museum was made by Robert Fieux. The design is based on a welded aluminum frame onto which four L-shaped aluminum angles are fit with screw mechanisms (fig. 78a). The screw mechanisms have two parts, one of which is numbered so as to calibrate the tensioning adjustments made and the other of which is adjustable and is attached to a sleeve that runs through the L-shaped aluminum angle (fig. 78b). The L-shaped aluminum angles have strips of wood attached to them so that one tacks or staples into the wooden strip.

In the original Fieux design of the temporary stretchers, rubber strips have been taped along metal surfaces to act as physical buffers between other delicate work-table surfaces (figs. 79, 80). The stretcher is not commercially available.

- *Guitar tensioning stretcher*

Andrea Rothe of the J. Paul Getty Museum designed this stretcher (fig. 81). In order to make this type of temporary stretcher, a strainer is adjusted so that screws are driven through the flat piece of the stretcher members at regular intervals along all four edges of the strainer. These screws have holes that allow for a thread to be passed through and tied securely to the screw piece. On the outer edges of the strainer members, guitar tuning pegs are inserted so that they engage with the threads of the screws. The guitar tuning pegs allow for the mechanical adjustment of tension of the canvas since as the screw turns, the thread that is attached to that particular screw creates a pulling tension at the point of adhesion to the canvas. The tensioning adjustments in this temporary stretcher design are similar to the principle design of the treckers used in tear-mending treatments (Demuth and Heiber 2000).

A creative usage of the strainer is illustrated in figures 82, 83 and 84. Elizabeth Mention of the J. Paul Getty Museum used the strainer to create a pronounced weave pattern in a piece of canvas that was to be used as an insert in a large loss to a canvas painted by Orazio Gentileschi. A piece of canvas was placed under uneven tension in order to create a distortion in the perpendicular weave that matched the original canvas in need of the insert. While on the temporary strainer, the piece of canvas was sized with a dilute solution of Rhoplex AC 33 (manufactured by the Rohm and Haas Company) in order to set the weave distortion and was then used as an insert.

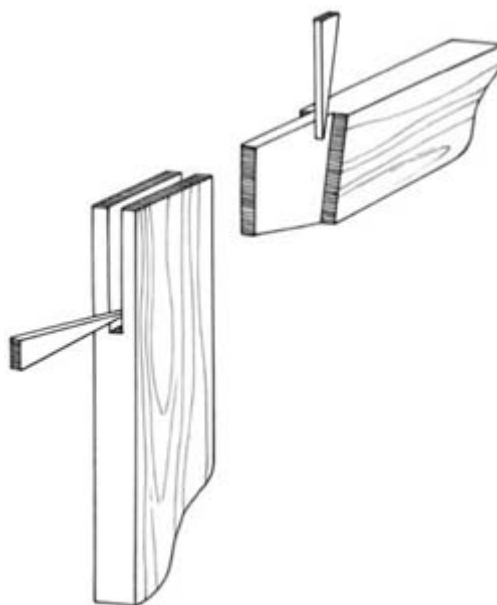


FIGURE 75 Huston temporary stretcher with outside keys

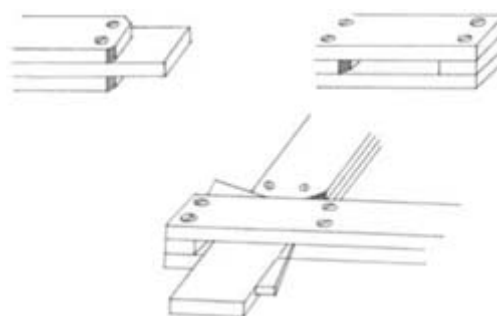


FIGURE 76 Konrad temporary stretcher with outer and inner keys

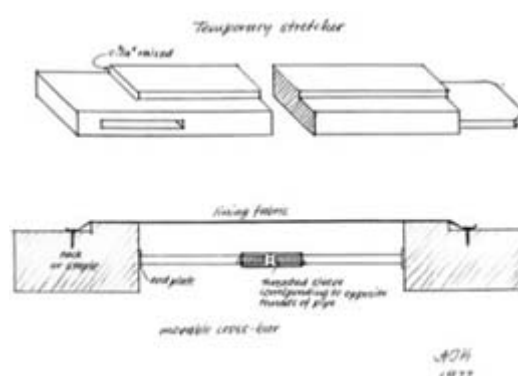


FIGURE 77 Konrad temporary stretcher with inserted tensioning adjustment



FIGURE 78a Fieux aluminum temporary stretcher

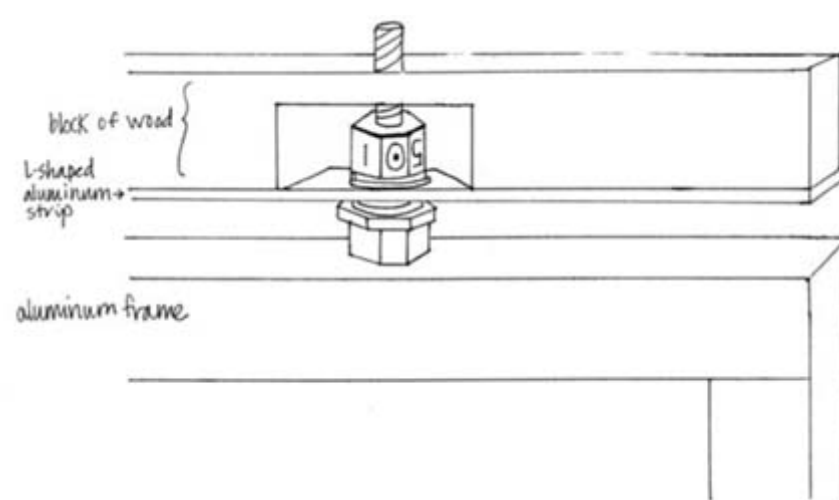


FIGURE 78b Detail Fieux aluminum temporary stretcher



FIGURE 79 Fieux temporary stretcher

Photograph courtesy of The J. Paul Getty Museum, Los Angeles; © The J. Paul Getty Museum



FIGURE 80 Corner of Fieux temporary stretcher

Photograph courtesy of The J. Paul Getty Museum, Los Angeles; © The J. Paul Getty Museum

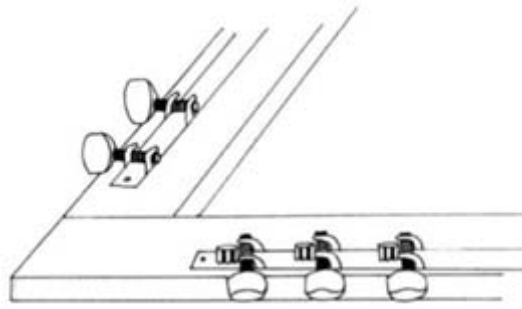


FIGURE 81 Rothe temporary stretcher with guitar tensioning

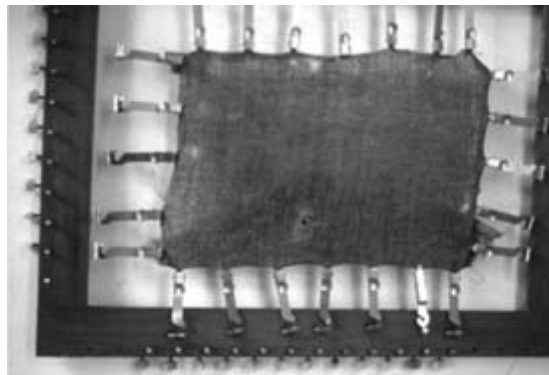


FIGURE 82 Rothe's temporary stretcher used for preparing a canvas insert

Photograph courtesy of The J. Paul Getty Museum, Los Angeles; © The J. Paul Getty Museum



FIGURE 83 Preparing a canvas insert using Rothe temporary stretcher

Photograph courtesy of The J. Paul Getty Museum, Los Angeles; © The J. Paul Getty Museum



FIGURE 84 Canvas insert in Gentileschi painting. Treatment by Elisabeth Mention

Photograph courtesy of The J. Paul Getty Museum, Los Angeles; © The J. Paul Getty Museum

Tips for Making and Handling Temporary Stretchers and Strainers

Tips for making and handling temporary stretchers and strainers were occasionally included in the 2001 survey responses and have been listed below. Other sources of tips come from articles about stretcher design and construction and have been included in the references.

- Wooden member size depends on the size of the painting.

- Clamps can be used to keep a larger stretcher in plane by clamping the corners and/or to clamp the stretcher to the table.
- One can use reinforcement plates (flat metal plates that are straight or L-shaped or wooden bars screwed or nailed in place) at the corners of a temporary stretcher or reinforcement cross bars on stretchers if the canvases are particularly heavy or large.
- For stretchers constructed with cross bars, the shortest cross-member is recommended to be the continuous cross bar, while the longest cross-member support should be two separate pieces that rely on the continuous bar for positioning and support (Booth 1989, 38).
- A raised outer edge on the stretcher bar members may allow for the stretched canvas to be in closer contact with a hot table.
- If aluminum is used at the corners of a stretcher, round the metal to prevent damage to the canvas and loss of tension.

Methods of Tensioning Adjustment

Canvases

In the 2001 survey, most conservators reported using traditional methods of attaching canvases to temporary stretchers constructed of wood. Those methods included the use of pushpins, staples, tacks, Velcro®, and Beva®-371. In qualifying how these materials were used, conservators mention using pushpins for an initial stretching of the painting, allowing for them to position the canvas and establish appropriate tension. The use of pushpins, tacks, and staples were all mentioned as allowing for local adjustment of the tension of the canvas. Short staples were described as more easy to remove when one uses a staple gun. Exceptions to these traditional methods are found in custom-made stretchers discussed previously in section 3.6.5

Secondary support

Most conservators who responded to the 2001 survey identified keys as the preferred method of adjustment. Expansion bolt stretchers were also regarded as providing good control of even tension.

Author's note: I would like to thank the following individuals for their contributions in compiling surveys and sharing contributions and ideas for this chapter: Barbara Buckley, Mark Leonard, Elizabeth Mention, Rob Proctor, Andrea Rothe, and Yvonne Szafran.

Tiarna Doherty

Submitted February 2007

NOTES

¹ “Type 1-c. *Half lap and pin*. Reported occurrences: American portrait, about 1845; Ralph Earle, American, early 19th c.”

² “Type 6-a. *Single fork mortise, dovetailed and keyed, often rotary*... Reported occurrences: Tharrats, Spanish, 1962.”

³ “Type 6-b. *Double fork mortise, keyed brace*...Reported occurrences: Mexican, 17th c.; Mexican, 18th c.; Bassano (probably replacement).”

⁴ The small points filled with X-ray dense ground/paint material found in regular intervals along the inside edge of the strainer were not noted at the time of the 1995 Tomkiewicz publication. This observation complies with methods of adhering fabric to a secondary support with the aid of thorns, nails, or pegs that are subsequently removed.

⁵ These paintings were examined for an exhibition organized by the Brooklyn Museum of Art in 1995: *Converging Cultures: Art and Identity in Spanish America*. 1996. ed. Diana Fane. New York: Harry N. Abrams, Inc.

⁶ “Type 2-a. *Simple mortise and key*. Reported occurrences: Chester Harding, American, about 1821; Vigée Lebrun; Miro; Rembrandt (probably replacement...cross piece dovetailed).”

¹ To date, the largest painting mounted on a Starofix stretcher is the 33 x 39-foot backdrop of the Opera House in Zurich conserved by Aldo Hug in 1984.

¹ Technically, the only way a stretcher could effect a continuous, uniform proportional expansion would be for it to be made of a flexible, stretchable material.

² When using a shaper, the number of passes is determined by whether the dado is stacked to cut the upper and lower faces of the tenon at once or whether the stock must be turned over for a second pass on the opposite face. When cutting the joints on a band saw, the entire stretcher bar must be tilted up and held against a jig in order to cut the angled space necessary for the key. This operation can be quite unwieldy and dangerous with stretcher bars in excess of 2.5 meters (~8 ft.).

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