# NON-INVASIVE FOUNDATIONS FOR REUPHOLSTERY

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The foundation of an upholstery system is made up of components that carry the weight of the sitter and create the upholstered form. Traditionally it was tacked to the chair* frame. It must be securely attached to the frame to be strong enough to support occasional sitting and provide attachment points for show covers and decorative elements of the upholstery. For conservation purposes, the foundation should help preserve important information found on the chair frame and not stress or degrade the frame.

SPNEA has developed a number of conservation upholstery treatments, to meet a range of client needs. We call them non-invasive treatments because they were designed to eliminate the use (invasions) of upholstery tacks. Early non-invasive treatments were designed for use as museum displays. Some collectors, however, wanted to have their chairs re-upholstered with a correct period form and they wanted to sit in them. But they also wanted to protect the frames from the degradations of re-upholstery. While we still believe sitting use does not meet all the goals of conservation, we believe many important ones have been met by our treatments:

1. The chairs were treated as valuable historical documents deserving careful conservation.

2. Good scholarship supported the interpretation of appropriate form and decorative details.

3. Important documentary evidence on the frames was identified and protected.

4. Our treatments were much less stressful than the alternative, which was traditional re-upholstery. At best, the new upholstery treatment would not further stress or degrade the frame.

Traditional upholsteries have proven to be remarkably strong and long lasting. However, they subject chair frames to great stresses and most do not last longer than a few human generations. Before describing some of the foundations developed at SPNEA, the first step in this paper will be to review some of the components of traditional upholstery and the goals for non-invasive treatments will be presented. This will set a background for understanding the many and alternative roles that new materials must play when substituting for old.

**Traditional Upholstery Components**

1. Structural Rails

Chair frames are subjected to very demanding stresses. Sitting produces racking motions as well as shearing and load bearing stresses on timbers, tenons and mortises. Nailed on upholstery, particularly webbing, applies tension stresses (as the rails are bent inward by tautly stretched webbing) and torsion stresses, since the webbing is only tacked to one face of the rails. Furthermore, both these stresses increase during sitting.

Chair rails are of particular interest to conservation because they contain so many clues about previous upholsteries. Conservation treatments should aim to protect this evidence and to protect frames from stress.

2. Webbing and Sackcloth

Webbing supplies the load bearing strength of an upholstery. Often made of heavy linen, canvas or jute, it is nailed to structural framing in the chair's seat and back with large (1/2″ to 3/4″ long) upholstery tacks. It is usually stretched very tightly, which stresses frame members.

Sackcloth, which covers the opening inside the seat rails, supports the stuffing materials — horsehair, grass, moss, etc. Medium-sized (1/4″ to 1/2″ long) upholstery tacks attach it to the rails.

Of these two components, webbing is of greatest concern. However, neither one is used in display treatments. For sitting use treatments, webbing can be used in non-stress ways or replaced with other materials.

3. Upholstery Tacks

The primary challenge of non-invasive re-upholstery is to eliminate the use of the upholstery tack. This is not easy. Tacks are remarkably effective fasteners — strong, tidy, easy and quick to apply. In fact, no other uses of nails in furniture making are nearly as successful. However, they wreak extraordinary havoc, particularly to seat rails, when chairs have been re-upholstered many times. Important tacking evidence may have been obliterated and tacking margins become quite shattered.

The two styles of tack, the common tack and the decorative tack, cause different damage. Repeated use of the common tack chops and shatters the surface of the wood, and in conjunction with the stresses caused by webbing, can split sizable timbers. Decorative tacks, because they were re-applied along the same lines on the edges of rails, often split the edges from the rails.

4. Edgerolls and Stuffing

Edgerolls were made of a strip of fabric wrapped tightly around grass stems or curled hair. They were nailed around the outer edge of upholstered areas in order to hold stuffing materials in place and to maintain precisely rounded edges in padded forms.

Traditional stuffing materials varied widely. Grasses, mosses, several kinds of animal hair (although curled horsehair was the most preferred of all stuffing materials) and, later on, foam rubber were all used. Springs were introduced in the 19th Century as a way to deepen stuffing materials. Cotton batting was used as a surface layer (skimmer) above the curled hair stuffing in later upholsteries.

These materials create the form of an upholstery but rarely stress the chair frame. However, upholstery springs, which are part of the padding, do stress chair frames. Once the intended use for the chair is known, any of these materials can be replaced with substitutes that do not damage the frame.

5. Show covers and Decorative Elements

These components are not part of the foundation, but conservation treatments must be designed to include methods for attaching them so they have a convincing appearance. They must also be attached securely enough to withstand the level of use intended for the treatment. Some of the most difficult and time-consuming parts of treatments involve providing secure, hidden grounds for attaching surface elements.

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* In this paper, the term "chair" will refer to all types of upholstered furniture, except where specifically noted otherwise.

**Goals for Non-Invasive Treatments**

Some of the goals for non-invasive treatments, such as avoiding the use of upholstery tacks, have already been stated. Others goals of treatments were implied. The overall goals are to:

1. have a convincing appearance;
2. accurately reflect historical evidence found on the chair;
3. protect historic information on the frame as well as protect the frame itself;
4. isolate upholstery stresses from the frame;
5. provide means to securely attach upholstery components to the chair frame; and
6. be strong enough to withstand accidental or intentional sitting (depending upon the client's requests).

Some other goals of SPNEA's non-invasive treatments (besides the AIC's general goals for treatments) may become apparent when the examples are discussed. They are to:

1. use readily available materials that are appropriate for the skills at hand;
2. use materials of adequate stability for the expected use of the object (for example, zinc-chromate plated steel screws have been substituted for stainless steel ones at a fraction of the cost);
3. draw upon the full range of available skills, such as woodworking, upholstery, sewing, curatorial, etc.; and
4. develop treatments around the skills available.

**Display Use Treatments**

Early non-invasive treatments were intended for display use only. They were notable for making extensive use of woodworking skills and alternative materials. These skills and materials were used to make the foundations of treatments, while the upholsterer's skills and traditional materials came into use when the final form and surface were completed. As treatments became more sophisticated, the skills of the upholstery and woodworking conservators have become increasingly interwoven, with upholstery skills becoming essential once again to creating the foundation.

Foundations were designed around many characteristics of high-density (6.2 lb.) Ethafoam that we found desirable. (Hereafter, the term "Ethafoam" refers only to the high-density Ethafoam that we use in upholstery treatments.) Ethafoam is a sealed cell, polyethylene foam that is water proof, virtually nonflammable, and chemically stable. It is easily worked with many kinds of cutting tools: table saw, band saw or jig saw for large cuts; a hand held power planer and a straight handled, Swedish pushknife (name used by Woodcraft Supply, Inc.) for shaving; and a rasp for rounding. We have, however, observed some dimensional instability when a lower density Ethafoam was exposed to moderate heat (photo lamps placed 2-4 feet from the material for several hours).

**1. A Side Chair**

The re-upholstery of the "Wendell" side chair (SPNEA Collections, 1987.20) is a good example of how woodworking skills were used in a treatment, and of the many functions served by the foundation. As a foundation for this leather-covered, over-the-rail treatment, a piece of 2″ thick Ethafoam was shaped to the profile of surviving upholstery padding found on a similar chair. In this case neither the prototype nor SPNEA's Wendell chair had edgerolls in their initial upholstery. Thus the curve of the pad "broke"

somewhat sharply at the rails because there was no edgeroll to provide a transition curve between the flat faces of the rails and the broad curve of the seat deck.
For this treatment, Ethafoam replaced missing padding, accurately imitating its form and even its function, for Ethafoam is strong enough to support a sitter. Some other features are worth noting:

1. The new pad was held in place by Ethafoam cleats glued only to its underside using acrylic hot melt glue.
2. The underside of the pad served as the pinning ground for attaching the showcover to the chair without nails. Use of pine permits the whole treatment to be quickly removed and remounted.
3. The firm Ethafoam pad served as a form for stretching the new leather showcover.
4. The new pad replaced all the under upholstery components and eliminated the use of webbing and tacks, the two most stressful components of traditional upholstery.

**2. A Belter-Style Sofa**

One of our most unusual treatments was the upholstery foundation to a Belter-style sofa. The back and arms formed a continuous, curved panel that was to receive a tufted show cover. Because of the half-over-the-rail detail, we did not attempt to completely avoid using tacks. However, since only the show cover had to be secured with tacks, many fewer tacks were required than for a traditional re-upholstery.

An Important first step was building a secure foundation. Two-inch thick Ethafoam blocks substituted for the traditional webbing and spring foundation on both the back and seat deck. Two pieces made up the seat deck, while five formed the back. The central three on the back were flat. The curved forms of the outer two, fitted to the compound curves of the arms, were formed by sawing deep, vertical curfs, spaced about 1 1/2″ apart, in the outer faces of the blocks. After the blocks were accurately fit, Ethafoam wedges, cut to fit into the open “V’s” of the curfs, were pinned into place. The wedges maintained the curved form of the pads and prevented from the sofa frame from bearing that stress. Upholstery pins, instead of glue, permitted later disassembly without damage to either the frame or the pads. Wooden tabs were carefully fit to spaces in the sofa’s back frame and the Ethafoam was screwed to these stable points.

Next the surface form was recreated. On the seat deck, a layer of 3″ polyester batting laid over the Ethafoam was shaped and held in place beneath a medium-weight cotton under cover. For the tufting on the back, tie-down locations were marked on the Ethafoam and 3/4″ holes drilled through them. Two 3″ thick layers of polyester batting and a light-weight cotton undercover were laid over the inside of the back. The tufting pattern was worked into them using linen twine ties pulled through the holes and pinned to the back face of the Ethafoam.

Undercovers for both the seat deck and sofa back were pinned to the edges of the Ethafoam to reduce tacking, while the showcovers, because of the half-over-the-rail detailing, were attached to the tacking margins with small upholstery tacks.

In this treatment, Ethafoam supplied a strong, stable foundation that could be securely attached to the seat frame. Compared to traditional upholstery, the treatment did not stress the sofa frame and it reduced the damages caused by tacking. It also served as a platform for two types of surface treatments -- the plain seat and tufted back.

**3. Easy Chair Treatments**

Display treatment foundations for easy chairs were built mainly of Ethafoam. Woodworking conservators constructed a strong, stable foundation whose form could be refined and completed by upholstery conservators. Surface elements of the treatment were as close to traditional in appearance and assembly as could be achieved without using tacks as fasteners. (In fact, it has been necessary on many treatments to use 5 to 10 tacks.) The interiors, however, were Quite untraditional (although straightforward), for there were complicated fastening problems to overcome. The essential components of the foundation were:

1. A 1/4″ thick plexiglas seat deck.

Plexiglas is a stable for the seat deck, and adequately strong to support occasional sitting. If the front rail was badly warped, a wooden lip, shaped to match the contortions of the rail, replaced the front edge of the plexiglas. The deck was held in place with wooden bars fit precisely to the inside of the rails and screwed to its underside. Ethafoam cleats, also screwed to the seat deck, fit around the inside of the seat rails to serve as pinning grounds for fabrics.

The deck was capped by 3/4″ thick Ethafoam formed to include an edgeroll along the front edge. The edgeroll section, initially 1 1/2 in. thick by 6 inches wide, was traced on the underside with the pattern of the front edge of the seat rail. Using a router to remove material inside the traced line, a bandsaw to make a bevelled cut just outside the line, and a rasp for rounding, the edgeroll was formed as part of the edge of the front 3/4 in. thick pad. Details of the new edgeroll simulate traditional ones: capping the front edge of the rail (flaring slightly outwards) 3/4 in. height.

2. Back and wing pads formed out of 3″ thick Ethafoam.

Easy chair padding is often at least 3 in. thick at its thickest points. To hold the pads in place accurately, 1/2 in. deep rabbets were routed around their edges to match the configuration of the voids within the back and arm frames. Surfaces were shaped with draw knives and rasps to simulate stuffing forms original to the period. Edgerolls were built into the form of the arm pads as a 3/4 in. thick leading edge.

The back and wing pads were bevelled to approximately 45 degree angles on the vertical edges where they met. A 3/4″ gap between the pads allowed under and show covers to be pulled through. This gap was filled with the batting when final form was given to the pads by a covering layer of polyester batting.

3. Arm scrolls.

The arm scrolls, which were vertical on the first chairs in our treatments, were sheathed with curved, tapering Ethafoam pads and half-dovetailed to the main wing pads. As a final step, the pads were tied to the frame members with polyester ribbons.

4. Wooden legs for the wing pads.

Ethafoam compresses when squeezed continuously. Thus it will gradually sag down the arm frames) where the the pad no lower supporting edge because of a 3/4 in. gap for a fabric pull-through. A “T” shaped wooden leg was set into tightly fitting slots routed in the lower outside face of the each pad carry the weight of the pad. The leg stood on the plexiglas of the seat deck. Polyester ribbons fastening the pads to the chair frame prevented the pads from being dislodged during handling.

5. Rail sheaths for attaching covers.

Both the under cover and show cover must be attached to the chair in the angles behind the arm cones, or under horizontal arm rolls, where they occur. Traditionally they were tacked to these inside corners. Our initial solution to this problem was an aluminum clamp screwed to the Ethafoam arm pad. It worked adequately well, but it was a woodworker's solution. When we began to adapt the non-invasive treatment to the demands of sitting use, an upholstery conservator developed a system for sheathing the frame members that were to serve as grounds for attaching upholstery components. We now regularly sheath frame members where strong attachment points are needed and sew the upholstery to the sheaths.

Sheaths were made from sheet polyethylene cut to match the shapes of rail faces and machine stitched to heavy-weight linen. The linen/polyethylene panels were sewed together along the edges of the rails. Polyethylene strips were only required for one or two faces of the rails. Besides preventing the sheaths from twisting around the rails, they also masked and recreated lost edges of rails and held loose materials in place. The linen served as the sewing ground.

6. Polypropylene mesh sheath.

Polypropylene mesh can be substituted for the sheet polyethylene. While not as stiff, it is useful for securing decorative tacks to rails. For this treatment, we use a new type of decorative tack that has split, or double, shanks. It can be pushed through the show fabric, under cover, linen and mesh and then flared on the back side. This is much stronger and more chemically stable than gluing tack heads to the show cover.

While the goals for early treatments included adequate strength to survive accidental sitting, comfort was not a consideration. Even though the seats of the easy chairs were finished off with down cushions, the plexiglas decks were still noticibly hard. In fact, the very firm surface (even with a layer of batting over the Ethafoam) was intended to discourage extended sitting. Even with a goose down seat cushion, sitting on these "easy" chairs was hard.

**Sitting Use Treatments**

We, as conservators, assume upholstery conservation treatments will be used for display. As mentioned at the beginning, some owners wanted to re-upholster period chairs for use, but they wanted to protect the chairs from the damages caused by traditional re-upholstery.

Initially we answered this request by designing treatments to make sitting tolerably comfortable. While owners usually felt this was a good solution, their guests complained. More recent treatments have made fuller use of traditional materials in order to provide the expected levels of comfort. Both types of treatments will be reviewed since each has appropriate uses.

1. Combined Plywood, Ethafoam and Horsehair System

At first we modified the Ethafoam display treatment to make the main weight supporting areas, the back and seat, comfortable. The treatment for the arms was not changed.

For greater strength, the plexiglas on the seat deck was replaced by 1/4 in. baltic birch plywood. The

Ethafoam deck pad was replaced with commercial edgeroll stapled to the front edge of the plywood and with several layers of 1/4 in. thick "Insulpad" (moderately dense, non-woven, resilient polyester pad) for increased resiliency. The traditional goose down and feather filled cushion was still used.
The back required a more comfortable treatment than Ethafoam. A sheet of 1/8 in. thick baltic birch plywood was fastened to the back frame using 3/8 in. wide polyester ribbon. The ribbons were stapled to the plywood, drawn through 1/2 in. diameter holes drilled at approximately 8 in. intervals around the edge of the plywood, pulled tightly around the rails, and again stapled to the plywood. (An electric staple gun is almost a requirement for this procedure.) Staples do protrude through the thin plywood, but we bend them over for better gripping strength. As protection against abrasion and squeeking, strips of "Pelon" (thin, non-woven, low-density polyester pad) separate the plywood from the chair frame.

In this use, plywood replaced the traditional webbing and sackcloth, but the rest of the treatment followed traditional methods. Linen cord stuffing ties were stapled to the plywood and curled horsehair worked on the recreate the back pad. The under cover, pulled around the four frame members and stapled to the back of the plywood, served as a sewing ground for attaching the show cover.

On some other sittable treatments for chairs with horizontal arm scrolls, Ethafoam was used only to fill the voids inside the arm frames and support sheet polyethylene/linen sheaths fit tightly around the arm frames. Secured by stuffing ties sewn to the linen, a thin layer of curled horsehair padded out the arm. This second type of treatment was easier to apply on this type of arm.

2. Plywood and Horsehair System

Our latest non-invasive re-upholsteries have made little use of Ethafoam. One-eighth inch baltic birch plywood, secured to arms and backs with polyester ribbons, substituted for webbing and sackcloth. Arms and backs were padded in curled horsehair to feel like traditional padding. In fact, the flexibility of the thin plywood is quite similar to the flexibility of webbing, even permitting the plywood to be bent around slight curves. Sawing curfs in the plywood encourages it to bend around even sharper curves.

The final developement, for the seat deck, had already been worked out on some earlier treatments for side chairs where the seat rails were too fractured by upholstery tacks to safely hold webbing. In place of the 1/4 in. plywood deck, we built a seat insert that gained rigidity through its "L" shaped rail cross-section. Yellow poplar rails, 1-1 1/4 in. wide and as thick as the chair rails, were fitted around the inside of the seat opening leaving just enough looseness to slip in a barrier layer of "Pelon". They were capped by a flange of 1 /4 in. baltic birch plywood, screwed to their top faces and extending to the outer edges of the chair rails. As final steps, the plywood was trimmed flush with the inside of the new rails and the rails screwed together at the corners. The seat opening was then strung with linen webbing to recreate the original type of support.

After using some of the commercial edgerolls, we returned to making our own from Ethafoam. They were firmer than the commercial ones and could be quickly and exactly configured to match our needs. We cut them out on a table saw and shaped the curved edge with either a rasp or rounding-over bit in a table mounted router.

**Conclusions**

There are several ways to build strong, secure, stable upholstery foundations that largely eliminate the damages caused by traditional re-upholsteries and that preserve chair frames and the evidence they

contain. Foundations can be designed to satisfy the needs of different clients, ranging from preservation to a balance of preservation and use.

Our early non-invasive treatments were designed to be used for display only. Built upon foundations made primarily of Ethafoam, they met the criteria for sound conservation — stable materials, reversible treatments, preservation of evidence, interpretation based upon sound evidence. More recent treatments have allowed us to meet these same criteria while also permitting owners to use their chairs for sitting. To gain an acceptable level of comfort, the new treatments have made use of traditional upholstery materials and techniques. But to avoid using tacks and to reduce the stresses inherent in traditional upholstery, and to build strong foundations for the upholsteries, new and different materials and techniques have been adopted.

Designs for both types of treatments were based upon understanding the capabilities and shortcomings of traditional upholstery and working within a framework of goals for conservation treatments. This meant that upholsteries used for display and those for sitting were designed within a common framework.