A VERSATILE MANNEQUIN DESIGN

GWEN SPICER

ABSTRACT

This paper discusses the mannequin design developed for the Smithsonian National Air and Space Museum's (NASM) exhibit, *America by Air*. It is a design that has been used by the author for several other projects subsequent to its development. NASM wanted an easy-to-dress mannequin form, for both male and female garments, that was made from a list of materials specified by them. A design was created with the help of SmallCorp Inc. What differentiates this mannequin from others is the internal armature, which later became known as the "side-ways ladder." The internal armature makes the form easy to produce, reliable and versatile. One step of the mannequin's production is delegated to metal working specialists. This allows the conservator to focus on shaping the Ethafoam. Often conservators try to undertake all steps of mannequin production. Now SmallCorp Inc can create the armature onto which the mannequin is built.

UN VERSÁTIL DISEÑO DE MANIQUÍ: RESUMEN – Este documento trata acerca del diseño de maniquí desarrollado para la exhibición "America by Air" del Museo Nacional del Aire y del Espacio (NASM) de la Institución Smithsonian. Es un diseño que la autora utilizó en otros proyectos anteriores a su desarrollo. NASM necesitaba la forma de un maniquí fácil de vestir, tanto para prendas masculinas como femeninas, hecho con una lista de materiales especificados. Se creó un diseño con la ayuda de SmallCorp Inc. Lo que difiere es la armadura interna, que más tarde se dio a conocer como "escalera lateral". La armadura interna hace que la forma sea sencilla de utilizar, confiable y versátil. Una etapa de la producción del maniquí se delega a especialistas en metalistería. Esto permite que el restaurador se concentre en dar forma a la espuma de polietileno Ethafoam. A menudo los restauradores tratan de llevar a cabo todas las etapas de producción. En este caso SmallCorp Inc. se encarga de crear la armadura sobre la cual se formará el maniquí.

1. INTRODUCTION

This paper is not solely about the 33 mannequins built for the Smithsonian National Air and Space Museum (NASM), but rather about the mannequin form that was designed for the project. It is a design that has since been used for several projects, and it is well suited for many others (fig. 1). This mannequin design resulted from needs established by the staff at NASM who wanted an easily dressed form for both male and female garments. They also had a list of very specific materials. With the help of Molly Wood at SmallCorp Inc., a design was created. What began as a concept sketch by NASM staff with two vertical posts forming an internal armature and two independent torso forms ultimately became known as the "side-ways ladder". The ladder is embedded into two halves of vertically positioned 5.1 or 7.6 cm (2 or 3 inch) thick Ethafoam®. The torso sections are stacked and slide up and down on vertical posts or stands. They are supported in place and at the desired height with stop-clamps.

2. BENEFITS & VERSATILITY

This mannequin design has many benefits. Many conservators have experienced the occasion where hours are spent carving and covering Ethafoam® only to have it inserted at an incorrect angle onto the metal post. With this design, the placement of the armature ensures straightness on the base. In using this design we have found that the process is quite quick. Dressing of the mannequin is made simple as all of the parts disassemble (fig. 2). The design is not limited to a fashion period or ethnic group; a full range of contemporary garments can be supported with this design.

Figure 1 (left): An exhibition case at the National Air & Space Museum for "America by Air". Figure 2 (right): Dressing of the assemblage is made easy, as that the embedded armature easily and smoothly slides down the base posts.

An aspect that should not be overlooked is that this design separates talents and knowledge of the conservator and the metalsmith. This arrangement is found at larger institutions, but now those in smaller museums and in private practice can delegate or outsource this part of the process. The hope is that the design is successful to such a degree that an institution can mix and match components in order to display a wide variety of costume garments easily over the course of many exhibits.

3. MANNEQUIN COMPONENTS

3.1 INTERNAL ARMATURE

The internal armature is a ladder-like structure made of two vertical 2.5 cm (1 inch) diameter aluminum tubes separated by two flat horizontal aluminum pieces. The inside diameter of the vertical tubes is sized to slide easily on the posts of the base. This ladder-like armature is then embedded into two pieces of vertically positioned 5.1 or 7.6 cm (2 or 3 inch) thick Ethafoam®.

The number of armature sections needed for each mannequin is based on each specific garment. Armatures can be measured for single or double torso sections. A double torso assemblage would include one section for the bodice, or upper torso, and one for the hips, or lower torso. The armature sections can be sized for the particular garment. Therefore the upper flat part supporting the shoulders can be made longer or wider, which would be necessary for a heavy coat or jacket. The tube height is determined by the waist to shoulder measurement for the upper torso and on the waist to in-seam measurement for the lower torso (fig. 3a). An internal armature can also be designed to bridge to two torso sections, also known as the elongated torso (fig. 3b). The tubes are positioned according to leg spacing and further described in section 3.2.

Figure 3a (left): Internal Armature embedded into the Ethafoam plank; Figure 3b (right): An elongated torso with stop-clamp access cavity.

The torso sections are stacked and slide up and down on the vertical posts or stands. They are supported in place with stop-clamps. The stop-clamp holds the internal armature at the desired height on the posts. Therefore adjustments can be made at any time and performed easily and smoothly (fig. 4b). The stop-clamps are sufficiently secure to the posts to enable numerous stacking torso components. A complicated garment might require several independent supports that could be stacked.

Figure 4a: Base with posts.

Figure 4b: stop-clamp

3.2 BASES

The base posts act like legs, allowing trousers or leggings to be easily incorporated into an ensemble. The stacking of components with the flexibility of the stop-clamps allows for easy dressing and assembly of a full range of garments, where each component or the entire garment is supported and then placed onto the base as seen in figures 2 and 13c.

The smoothness, by which the internal armature slides along the posts, lowers the stress and handling of the mounted artifact. This can be useful for artifacts that travel. Garments can be transported on their mounts, separate from the base with the stop-clamps in the appropriate position. The base would then be positioned on the display deck, followed by the supported garment.

The spacing of the posts can accommodate each gender. A rough spacing for male and female forms has been determined through experience: 20.3 cm (8 inches) on center for males and 15.2 cm (6 inches) on center for females. SmallCorp can provide a square shaped base or for large projects round bases can be an option to order. The base and posts can be powder coated in a range of colors (fig. 4a). The weight of the base is sufficient to stabilize the mannequin, regardless of its height and the weight of the artifact.

4. MEASURING

To determine the individual sizes for each form and its necessary parts, a measuring checklist form is created (Appendix 1). This form was used when each garment was measured. The resultant measurements were then translated to sizes for the internal armatures. From this the flat pattern was created that is used for the outer dimensions and shape of the Ethafoam®.

The cross-section seen in figure 5 shows how the armature size is determined as well as how it is positioned in the Ethafoam®. Through trial and error we found that the top of the posts should end a few inches below the top of the upper torso. This allows room for the torso to be raised and lowered, while also keeping the torso stable.

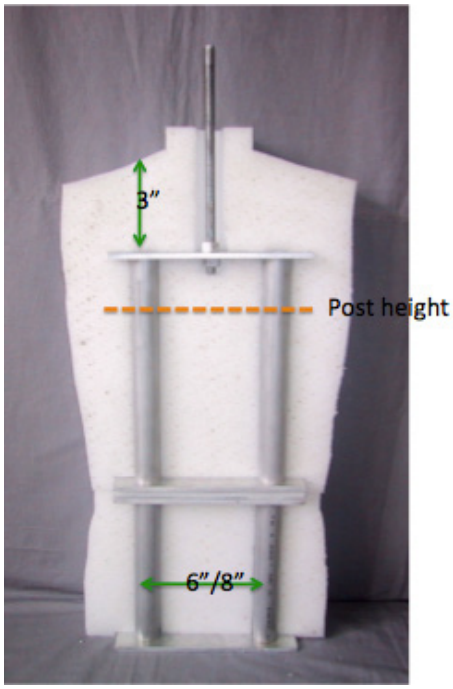

Figure 5: Cross-section of the armature with suggested placement measurements

5. POSITIONING

When two torso sections are used, both are imbedded into Ethafoam® and they are positioned onto the posts in contact with one another. The internal armature can be positioned in the form's silhouette as necessary, either at the bottom edge of the upper torso to align with the top edge of the lower torso (fig. 3a), in essence at the waist. An elongated armature that bridges two torso sections, as seen in fig. 3b can have Ethaform® that extends below the lower horizontal member. Access space to tighten the stop-clamps needs to be created.

6. EMBEDDING THE ARMATURE AND CARVING

The actual creation of the torsos is no different than how one would make any other mannequin form. Begin with a pattern for the estimated size of the garment and that will create the outer dimension of the Ethaform®. The location of the armature is determined at this point. After the shape is cut, the armature is traced. Figure 6 shows the armature on top of the paper pattern. Squareness of the armature is important when positioning. When square, the amount of carving and fitting time is reduced. It is at this time that you ensure that the form will be straight on its stand or base. As that each component is dependent on the other.

Another aspect of the form's design is the armatures position in the depth in the Ethaform®. The armature can be either positioned center of even thicknesses of Ethaform® or a mixture of thicknesses can be used or even the armature placed shallower on one side and deeper on the other. (See following discussion of Tight Support, 8.1)

Assorted knifes are used first to cut the straight lines when cutting Ethafoam® to accomodate the armature (fig. 7),and for cutting the vertical areas where the aluminum tubes fit. Woodworking tool do the best job. After some practice this is quite quick. The tool needs to be rocked gently side-to-side. It is also critical to stay level. One has a tendency to slope down with the tool as you move along. First cutting the outer edges of the channels with a straight knife will assist with keeping the channeling straight. The remaining stages are the same as those necessary for other mannequins made with polyester batting and stockinette. It is recommended that carving of the torso occur after it is positioned on the base. This both supports the torso section while carving and ensures straightness.

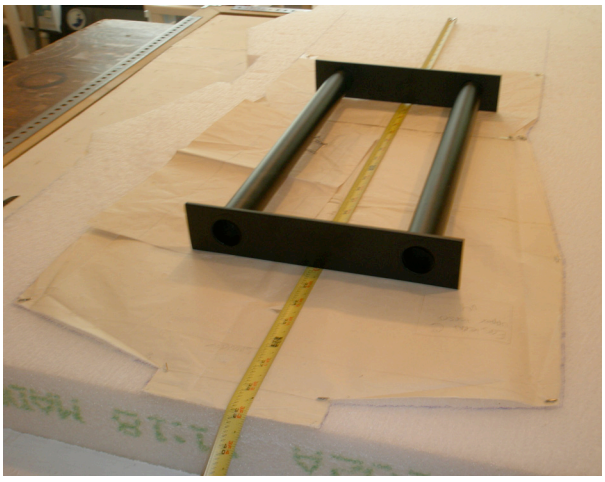

Figure 6 (left): Pattern and armature positioned on the Ethafoam in preparation for cutting. All components have been squared. The paper pattern is secured to the foam with t-pins. Figure 7 (right): Carving tools, including the curved wood chisel.

7. TYING THE ETHAFOAM TO THE ARMATURES (OPTIONAL)

The vertical tubes of the internal armature allow the Ethafoam® planks to be tied together with cotton twill tape as an option to the more permanent hot melt glue. Two holes are created in the Ethafoam® using a long sharp tool. An upholstery regulator was useful, but one could also use a long drill bit. Holes were positioned on either side of the vertical tubes. With tying, the Ethafoam® can be easily removed from the internal armature and saved. This allows for the internal armature to be reused with different sized Ethafoam®.

8. VARIATIONS AND ADD-ONS

Since the initial project, the armature design has been used for many projects and for a full range of three-dimensional artifacts. The following discusses some examples of how the form can be used and modified for a full range of situations, whether for better support, or interpretation of the artifact. This adaptability fully represents the design's versatility.

Wood armor from Alaska that measured 28" H was supported with a tabletop-sized armature designed to fit in a small display case or other limited space restrictions. The in-the-round display case allowed the visitor to closely inspect the artifact. The armor had previously been displayed flat high up on a wall, where it could not be easily seen. The armor's support consisted of a single torso section and base with short posts. The base was powder coated to match the case creating a sleek design (fig. 8). The posts were made the exact inside height of the internal armature.

Figure 8: Alaskan Armor on a short-style base, designed to fit into a display case and bonnet.

A nineteenth-century taffeta dress utilizes an elongated torso. The internal torso was made with slightly longer tubes, allowing the lower horizontal flat member to be positioned below the waistline. Therefore the garment was supported with one long torso armature instead of two shorter ones (figs. 9a-c). The dress's narrow waist was positioned along the armature's inner region of the posts. The lower horizontal member of the armature ensured support of the extra Ethafoam® necessary for the full skirt. With the location of the horizontal member, any potential sagging of the Ethafoam® is reduced if not prevented.

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Figure 9: 1830s Taffeta Dress: Figure 9a (left): The elongated torso armature. Figure 9b (middle): Armature with first layer of soft supports. Figure 9c (right): Fully dressed armature

In the exhibition, *Woven by the Grandmothers,* at the National Museum of the American Indian's Geroge Gustav Heye Center, all of the form's armatures for Navajo wearing blankets were made of PVC pipe. (Spicer & Heald, 1997) Here the same chief pose for this Navajo blanket was created with this new armature (figs. 10a-c). The PVC pipes were ideal for this temporary exhibit. They too were the internal armatures that were embedded into the Ethafoam®. The wide variety of fittings added to the flexibility of postures and poses. However, this one venue exhibit became a ten-venue exhibit, traveling to North, Central, and South America. In hindsight a more robust armature would have been better suited, and the metal armature making delegated to another specialty source. The tight exhibition schedule for this project only allowed for a production situation where the conservators performed all tasks or fabricated all mounting elements.

Figure 10: Woven by the Grandmothers: Figure 10 a (left): Forms on exhibition. Figure 10 b (middle): Mannequin form with rigid arm. Figure 10 c (right): Dressed mannequin.

For a re-creation of the Caroline G. Parker's Seneca garment from the Morgan collection, which has an over dress, wrap skirt and leggings, an elongated torso was used for both the skirt and dress (figs. 11a-b). By positioning the waist in the vertical tube region of the armature, like the Taffeta dress, plenty of room was available for the skirt's support. A wide cotton-webbing belt with Velcro fasteners was created.

Figure 11: Buffalo & Erie County Historical Society Figure 11a (left): The elongated torso, Figure 11b (right): The wrapped skirt held in place with a cotton-webbing belt secured with Velcro.

8.1 LEGGINGS, TIGHTS AND FOOT-WEAR

Legging supports were created by inserting a 2.5 cm (1 inch) diameter pipe into the legging support and a second set of stop-clamps. The pipes were embedded into two halves of the foam like the torsos. Ethaform® blocks were cut and then carved to the shape to fit the inside diameter of each legging, as seen in fig. 12.a. When it was time for dressing, the leggings were slipped onto the posts first, and then the upper torso were placed with its own set of stop-clamps. Had the leggings been taller necessitating a taller support, then only one set of stop-clamps would have been utilized (figs. 12a-c).

Figure 12: Leggings: Figure 12a (left): The cross-sections of the two halves of the Ethafoam supports. Figure 12b (middle): The supported legging positioned on the base post. Figure 12c (right): Placing the second legging onto the base

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One of the ensembles to be included in the NASM's exhibition had knit tights that were to be displayed with a mini-skirt. Each component was supported separately; the tights with batting and stockinette leggings and the skirt on a lower torso. When the armature was imbedded into the Ethafoam, it was positioned as far back into the form as possible. This allowed space in the front for the upper section of the tights. The tights were supported with a two-part system due to concerns of the long-term nature of the exhibition. The internal support for the leggings was secured to the torso with Velcro. The support extended above the waist of the tights and the soft side of the Velcro was attached to the extended area. Fig. 13.b shows the front side of the lower torso with the hook side of the Velcro. A stockinette diaper secured to the torso, gently supported tights, as seen in fig. 13.c to the upper front of the lower torso. (figs. 13a-d).

Figure 13: Tights: Figure 13a (top left): Supports for the tights and lower torso armature for the mini-skirt. Figure 13b (top right): Detail of the front face of the lower torso, Figure 13c (bottom left):. The supported tights in place with the stockinet diaper in position. Figure 13d (bottom right): The dressed lower torso before being positioned onto the base posts.

When a garment is displayed with shoes or boots, the same technique of moving the armature back behind the vertical center of the form can be employed. This creates space within most trouser legs for the footwear to be positioned in front of the base's post.

9. ORDERING FROM SMALLCORP INC.

Appendix 2 provides necessary notes and a checklist to assist when placing an order with SmallCorp Inc. Each component has its own needs, height, width, spacing etc. Standard sizes are being developed for small, medium, and large mannequins that also might be helpful for some.

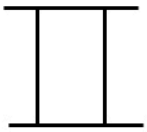
When ordering armature components from SmallCorp, several measurements are needed. Below is a list to guide you with those specifics:

1. Base – post heights and spacing.
2. Base shape – round or square.
3. Number of torso sections.
4. For each section you will need to know the height of the tubes and length of the flat members.
5. Color to be powder coated or the surface preparation.
6. Any additional special parts like heads and/or legs or other specialty support needs.

10. CONCLUSIONS

This "side-ways ladder" mannequin provides another tool in a conservator's arsenal for displaying three-dimensional costume artifacts. It is a design that can be easily adapted for different types and sizes of garments, making it easy to produce, reliable and versatile. The internal armature also ensures that the resulting mannequin will be straight and upright. By delegation one step of the mannequin's production to metal working specialists, the conservator can focus on shaping the Ethafoam® and supporting the artifact.

APPENDIX 1: MANNEQUIN MEASUREMENT SHEET



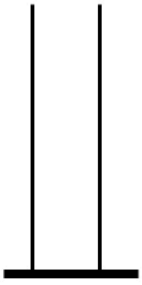
1. Shoulder Width:

Torso Height:

Waist Width:

2. Waist width:

Lower Torso Height:



3. Base: Square

Posts: (___)" Height

Posts: (___)" on center

Color:

APPENDIX 2: MANNEQUIN MEASUREMENT NOTES

FEMALE FORMS
1. Post widths mostly 6” apart.
2. Lower torsos heights are 8” for skirts, with typically 7” for pants.
3. Lower torso is Ethafoam minus 3” at waist (upper and lower horizontal are the same.)
4. Upper torso width is Ethafoam minus 3” at waist and 4” minus shoulder width.
5. Upper torso height is 3” minus shoulder to waist measurements.
6. Neck is 3” (from upper horizontal to lower collar of garment) plus 4” to base of head.

MALE FORMS
1. Post widths mostly 8” apart.
2. Lower torsos heights are typically 11”, three exceptions.
3. Lower torso is Ethafoam minus 3” at waist (upper and lower horizontal are the same.)
4. Upper torso width is Ethafoam minus 3” at waist and 4” minus shoulder width.
5. Upper torso height is 3” minus shoulder to waist measurements. (same as female)
6. Neck is 3” (from upper horizontal to lower collar of garment) plus 5” to base of head.

ACKNOWLEDGMENTS

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SOURCES FOR MATERIALS

Side-ways ladder mannequin Armature
SmallCorp Inc.
19 Butternut Street
Greenfield, MA 01301
Phone: 800-392-9500; 413-772-0889
Fax: 413-773-7386
Email: info@smallcorp.com

Ethafoam®
Dow Chemical
Midland, MI 48674
800/258-2436
Manufacturer: Thermal Foam/Syracuse, Inc.

Celluplank 220
John Jeffery
P.O. Box 1981
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Gwen Spicer, since 1995 a conservator in private practice in upstate New York, treats textiles, upholstery, and organic artifacts. She assists many small- to mid-size museums and historical societies with collections care, storage, exhibitions, and has become known for her innovative conservation treatment. Ms. Spicer also provides expertise in the areas of housekeeping strategies, integrated pest management, and disaster planning. She has taught and lectured around the world. She received her MA and certificate of advanced study in art conservation from the State University College at Buffalo. She has held internships in both the textiles and decorative arts labs at the New York State Bureau of Historic Sites. She later worked for the Rochester Museum and Science Center and at the Metropolitan Museum of Art. She is a Fellow of the AIC. Address: 305 Clipp Road, Delmar, NY 12054. E-mail: gwenart@capital.net