

MOUNTING MULTIPLE-PIECE ENSEMBLES FOR AN EXHIBIT OF PLAINS, PLATEAU, AND GREAT BASIN ATTIRE AT THE NATIONAL MUSEUM OF THE AMERICAN INDIAN

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ABSTRACT—This article describes the preparation of the mounting systems developed for the clothing and accessory ensembles in the “Identity by Design: Tradition, Change and Celebration in Native Women’s Dresses” exhibit at the National Museum of the American Indian. Approaches to the fabrication of custom-carved mannequins and the adaptation techniques required for these specific pieces are discussed in detail. This article includes the steps required to produce a fully supportive, easy-to-install mannequin form that satisfies aesthetic, curatorial, and conservation requirements.

TITRE—Problèmes et solutions lors du montage d’ensembles vestimentaires complexes pour une exposition d’objets amérindiens de la région des Grandes Plaines, des plateaux de l’ouest et du Grand Bassin au *National Museum of the American Indian* **RÉSUMÉ**—Cet article démontre la préparation des systèmes de support élaborés pour des ensembles de vêtements et d’accessoires pour l’exposition “*Identity by Design: Tradition, Change and Celebration in Native Women’s Dresses*” (Identité dans le design: tradition, changement et célébration de l’habillement des femmes autochtones) présentée au *National Museum of the American Indian* (Musée national des Indiens d’Amérique). Les stratégies élaborées pour la production des mannequins fabriqués sur mesure et les techniques requises pour ces pièces spécifiques sont expliquées en détail. Cet article présente les étapes requises pour produire un mannequin facile à installer et offrant un support adéquat, tout en satisfaisant les critères esthétiques, et ceux posés par les départements de la conservation et de la restauration.

TÍTULO—Complejidades y soluciones para el montaje de conjuntos de piezas múltiples de vestimentas usadas por los indígenas de la sabana, la altiplanicie y la gran cuenca para una exhibición en *National Museum of the American Indian* **RESUMEN**—Este artículo describe la preparación de los sistemas de montaje desarrollados para conjuntos de vestimenta y accesorios en la exhibición “*Identity by Design: Tradition, Change and Celebration in Native Women’s Dresses*” (“Identidad por diseño: tradición, cambios y celebración en los

vestidos de mujeres nativas”), en el *National Museum of the American Indian* (Museo Nacional del Indio Americano). Se discuten en detalle las propuestas para la fabricación de maniqués tallados y las técnicas para adaptación según los requerimientos de cada pieza específicamente. Este artículo incluye los pasos necesarios para producir un maniquí que ofrezca soporte total, que sea fácil de instalar y que satisfaga los requerimientos estéticos, curatoriales y de conservación.

TÍTULO—Complexidades e soluções para a montagem de conjuntos de várias peças para uma exibição de indumentária das Planícies, do Planalto e de Great Basin no *National Museum of American Indian* **RESUMO**—Este artigo descreve a preparação dos sistemas de montagem desenvolvidos para os conjuntos de roupas e acessórios na exposição “*Identity by Design: Tradition, Change and Celebration in Native Women’s Dresses*” (“Identidade através do design: Tradição, mudança e celebração nos trajes de mulheres indígenas”) no *National Museum of the American Indian*. As abordagens para a fabricação de manequins esculpidos personalizados e as técnicas de adaptação necessárias para essas peças específicas são discutidas em detalhe. Este artigo inclui as etapas requeridas para produzir um modelo de manequim totalmente sustentável, fácil de instalar, que satisfaz os requisitos de estética, de curadoria e de conservação.

1. INTRODUCTION

In March 2007, the Smithsonian’s National Museum of the American Indian (NMAI) in Washington, D.C., opened the exhibition “Identity by Design: Tradition, Change and Celebration in Native Women’s Dresses.” The exhibit showcased 53 historical and contemporary dresses made and worn by women of the Plains, Plateau, and Great Basin tribes (Her Many Horses 2007).

Many of the dresses were adorned with varied accessories, such as jewelry, belts, powwow crowns, and moccasins (fig. 1). The exhibit contained a total of 96 accessory objects associated with 25 of the dresses: 24 pairs of moccasins and leggings, 20 belts, 10 objects held in the hand area, and 18 objects, such as crowns and earrings, oriented as though on heads.



Fig. 1. Photo of the Pow Wow case platform in the “Identity by Design” exhibition showing several mannequin ensembles, each with many additional mounted pieces. Twenty-five of the 53 ensembles in this exhibit carried multiple mounted objects. Courtesy of the National Museum of the American Indian, Smithsonian Institution (26/5186, 26/5187, 26/5818, 26/5713). Photo by NMAI Photo Services Staff.

An aesthetic goal of the exhibit was to highlight the individual dresses while subtly suggesting the anatomy of the women who would have worn them. Head and hand areas were to be left “open” and objects would be mounted to indicate wearing. The mounts for the accessories were to secure directly to the mannequin form wherever possible.

An additional aspect of the design intention for this exhibit that affected mountmaking decisions was that the dress ensembles would be displayed on open platforms. This design aspect required an additional consideration of security in the mountmaking process for the accessories. Instead of attempting to have the mounts provide sole security for the objects, the mounts were designed as one of six deterrent layers in the security strategy. The other five layers of security were beyond the mounts. In addition to gallery guards, cameras, and platform motion detectors, physical barrier and distance were used by

placing mannequins at least 122 cm (48 in.) from the label rail, which was installed at a deliberate height to discourage climbing over or under. If one managed to avoid these security layers and tried to remove a piece, the mounts were designed to feel solid and offer some resistance while causing as little damage to the object as possible.

Another important design consideration was that the ensembles would be visible from all sides. The dresses had a protective acrylic wall set close behind them to allow details to be viewed more intimately from the back. This wall removed any opportunity to hide the fitting gaps caused by parts of the ensemble coming from women of different sizes. The finished mannequin needed to look cohesive, but all adjustments would have to take place within the mannequin and/or mount structures.

Although many of the display challenges required complex solutions, the similarity of types of objects

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Fig. 2. Pillow arm mannequin for a lightweight cotton Numakiki (Mandan) dress. The mannequin was intended to show the dress worn during pregnancy. The lightness of the fabric and the looseness of the cut allowed for use of attached pillow arms in this case. Courtesy of the National Museum of the American Indian, Smithsonian Institution (19/0628).

made it possible to approach the mountmaking in a systematic way. The process of streamlining this work led to solutions that became increasingly efficient and deceptively simple in appearance. Ultimately, the fabrication of the supports for these ensembles consisted of two key steps: the construction of the mannequin forms and their use as the base component in the mounting of the accessories of the ensemble.

2. THE MANNEQUIN FORMS

All of the mannequins for this exhibit were custom carved from Ethafoam 220 foam. This conservation-approved material was chosen for its familiarity to the mountmaker, ease of manipulation, and ready availability. Although the process was rarely completely linear, the general steps taken in the creation of each mannequin were as follows: determining poses and arm types, measuring and templating, creating the mannequin blank, fabricating the pole-and-rake support structure, carving and fitting, finishing, and finally fabricating the mount and connecting it to the finished mannequin.

2.1 DETERMINING POSES AND ARM TYPES

A curatorial and design goal of the exhibit was to express the modest, subtle, and symmetrical postures that women wearing these dresses would assume. Because the arms and their position were crucial in defining this pose, there was a desire to keep the arms angled as low and natural-looking as possible while maintaining minimal stress on the garment. Each dress was evaluated by conservation staff for its ability to withstand this kind of display, and lowest possible arm angles were determined. As a result of these consultations, the mannequins were organized into four main arm types: pillow arm, T, twill, and keyed.

2.1.1 The Pillow Arm

The most basic arm was the pillow arm, which was used only for sturdy, lightweight cloth dresses with no need of forward articulation and a lot of room in the underarm area for insertion of the arm without stressing the garment (fig. 2). These arms were made from polyester batting, which was covered with 8-cm (3-in.)-wide polyester stockinette to form a soft pillow and then were stitched directly to the mannequin so that they were nonremovable. Most often, mannequins might have just one pillow-type arm, whereas the other was detachable for ease of dressing (fig. 10). Seven of the mannequins used this type of arm exclusively.

2.1.2 The T Arm

The second family of arm types was called the T arm, although the arm support was more likely to look like an upside down V in an effort to achieve a more natural-looking pose (fig. 3). This arm type was the solution for the dresses in the exhibit that were top heavy due to heavy beading on their yokes. These dresses tended to have open, unstitched arms with large openings from the underarm to the waist. To allow strong, full support along the entire neck, shoulder, and arm area, this type of arm had an internal T skeleton made of an aluminum square tube embedded in the Ethafoam. The aluminum structure added rigidity to withstand the weight of the heavy beadwork, while adding minimal additional weight to the mannequin. The Ethafoam was carved to a size that fit through the largest open side under the arm of the dress. It was covered with polyester needle punch felt then stockinette oriented with the



Fig. 3. T arm mannequin for heavily beaded hide Yakama dress showing the mannequin's two-part structure and keyed V area. The weight of the beads on this dress required full support along the entire arm and shoulder area and an extra aluminum structure inside the T area to avoid slumping over time. Courtesy of the National Museum of the American Indian, Smithsonian Institution (14/3568, 13/7892 necklace, 23/0726 hat, 20/4297 ear ornaments). Photo by NMAI Photo Services Staff.

ribs of the fabric running lengthwise. This technique offered a useful friction to keep the hide of the dress from slipping and the seams from stretching. To help reduce the friction of the stockinette on the garment during dressing, removable Tyvek slipcovers created a slippery barrier for the arm, which could then be slid off once the arm was in position. Thirteen mannequins used this type of arm.

2.1.3 The Twill Arm

The third type of arm was the twill arm (fig. 4). This style of arm was implemented where no forward articulation was required in the mannequin's pose and where the construction of the dress required that the arm be separate from the mannequin torso. This type could support heavier weight dress sleeves than the pillow arm and allowed for easy and versatile connection with minimal manipulation of the shoulder area of the garment.

The arm structure started with a 8-cm (3-in.)-diameter backer rod, a closed-cell polyethylene foam product commonly used in the concrete industry (Nomaco 2009). The foam was wrapped with polyester batting as needed, then covered with 0.3-cm ($\frac{1}{8}$ -in.)-thick, polyester needle punch felt, and finally topped with stockinette. For a stronger connection to the mannequin body, some of these arms were fitted with

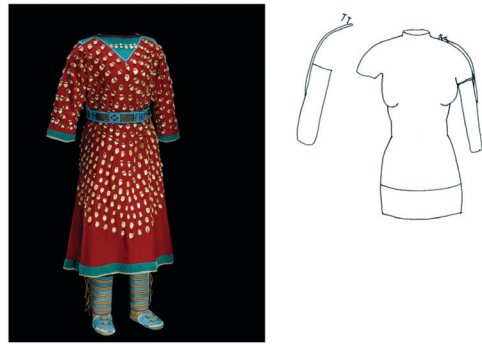


Fig. 4. Twill tape arm mannequin for wool and elk tooth Crow dress. This piece was well fitted with slightly heavy arms that needed to be dressed separately from the torso of the mannequin. Polyethylene foam backer rod arms are covered with polyester needlepunch felt and stockinette then finished with a twill tape tab that was secured with T-pins at the open neck area. Courtesy of the National Museum of the American Indian, Smithsonian Institution (12/6406, 21/6853 belt, 14/9546 leggings, 11/8006 moccasins). Photo by NMAI Photo Services Staff.

rare earth magnets that mated to magnets or steel strips embedded below the shoulder on the torso, allowing the arm to find its desired location with minimal garment manipulation. The twill arms were finished by stitching a twill tape band lengthwise from the wrist or upper arm area to shoulder, with a tab that extended beyond the upper arm to create a pinning attachment area. For this type of arm, the joining point between the arm and the torso was cut as low on the shoulder as possible to avoid creating a gap where the dress material could slump, but if a slight gap was created, the twill tape served to create a bridge to further support the area. The twill tape also stabilized the stockinette on the arm and kept it from stretching. Width of the twill tape used varied, depending on the amount of strength required. These arms were easily attached to the shoulders or neck areas by means of T-pins stuck through the twill tape tab into the foam at the open neck areas. This simple but solid connection was used for most of the dresses, 26 in all.

2.1.4 The Aluminum Keyed Arm

The final type, the aluminum keyed arm, was used only when arms needed to carry weight in a specific orientation that defied gravity (fig. 5) or were too heavy to be supported by the twill-type arm. This style of arm consisted of two parts: an aluminum

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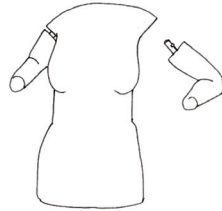


Fig. 5. Keyed arm mannequin for painted Arikara two-hide dress, ca. 1840. The curator requested the arms be bent slightly for this mannequin to show the details at the elbows, so a locking arm was required to hold the arms slightly raised and forward of the body. Courtesy of the National Museum of the American Indian, Smithsonian Institution (12/8931).

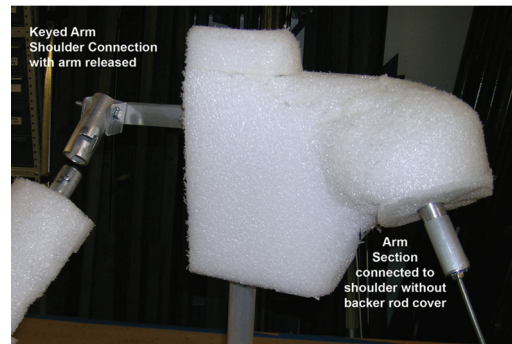


Fig. 6. A model of the aluminum "keyed" arm structure that was imbedded in the mannequins of that type. The proper right side shows the shoulder joint with arm released. The proper left side shows the arm structure connected to the shoulder. Photo and model Courtesy of Robert Patterson.

skeleton embedded into the foam of the torso and a connecting arm structure (Patterson 2006) (fig. 6). A tube in the shoulder area of the torso skeleton had a precut channel designed to accept the matching arm structure. The top end of the arm structure extended beyond the foam of the arm and slid into the shoulder tube. The arm locked into position by means of a raised button on the arm structure that followed the channel in the shoulder and keyed the arm in place. There was a threaded rod extending beyond the upper arm structure, which ran the length of the arm and added rigidity and the option of a connection point for accessory mounts in the wrist area. These arms were finished similarly to the twill arms with batting, then needle punch felt, and finally polyester stockinette. This type of arm was used on seven mannequins.

2.2 MEASURING AND TEMPLATING

Once it was determined which dresses would require which arm type, work on measuring and templating the dresses could begin. A thorough set of measurements and a template of the garment were required so that much of the mannequin-making work could be done away from the dress. For this exhibit, some objects had not been fully conserved at the time that work needed to begin on the mannequins, so handling was an even greater risk. For these reasons, templating was a crucial step.

The templates were the flat patterns of the garments (fig. 8) that could be used to assess fit and support with minimum use of the garment. They were not the same kind of pattern used to construct a garment but rather a measured outline of a finished garment that included important information for the mannequin maker, such as shoulder slope, distance from bust line to waist to hip, and other factors. Measuring and templating for this project took approximately 30% of the total mannequin-making time. Although this may seem like a large percentage of work time, this careful, accurate templating significantly reduced garment fitting and handling and mannequin fabrication and carving time.

Before templating began, relevant garment measurements were noted on the measurement sheet (fig. 7). Particularly important measurements for fitting these mannequins were noting the arm opening diameter (No. 5, smallest arm opening, on fig. 7) and the smallest opening diameter at the torso (No. 8, narrowest flat width, on fig. 7). Comments on the age of the wearer of the garment, arm articulations, and accessories with their pertinent measurements were also helpful. The display platforms in this exhibit would be deep enough to allow the garments to be displayed on anatomically accurate forms, compared with a flatter, more graphic display. This display meant that in addition to the garment's existing measurements, human anatomical

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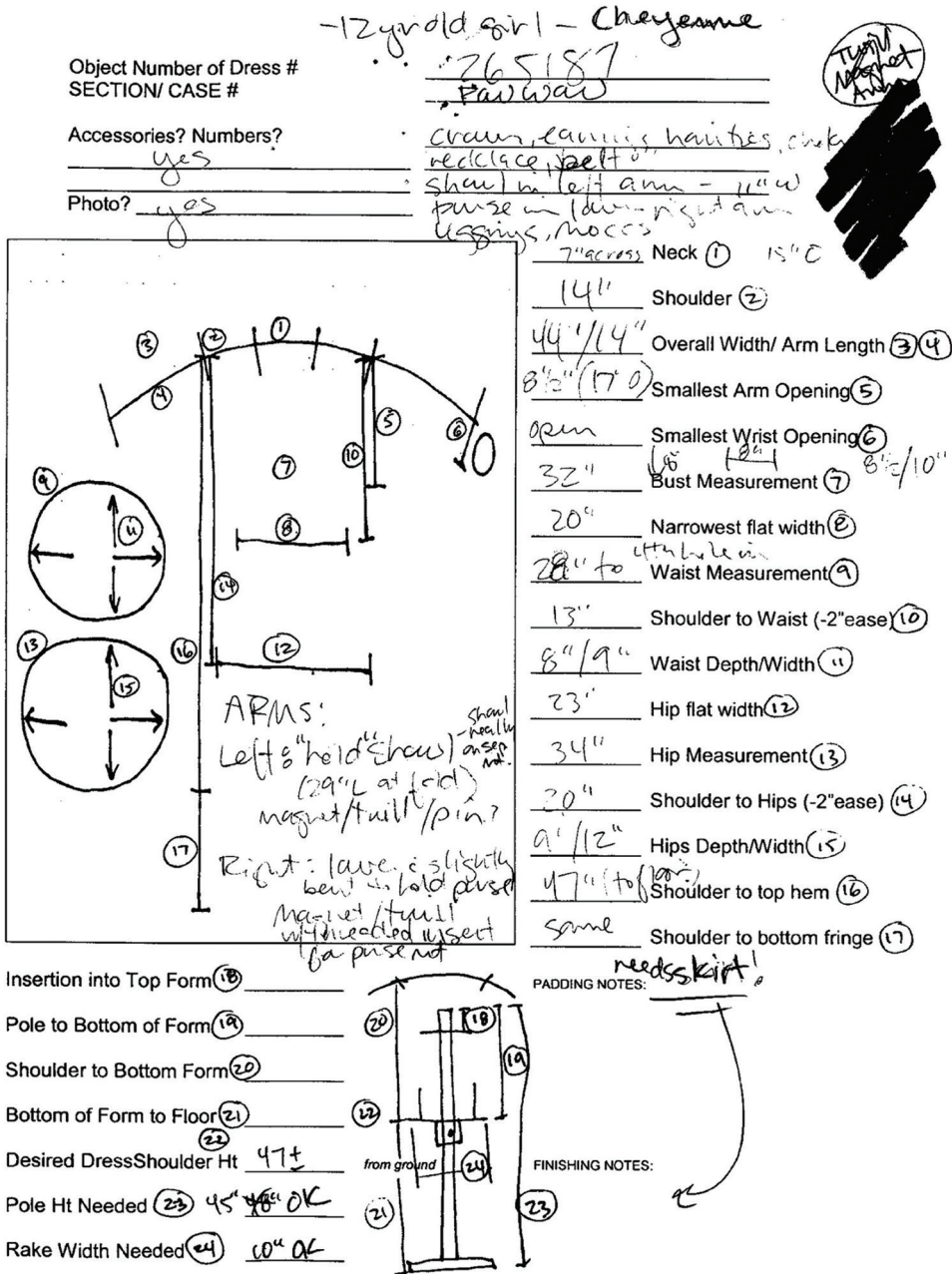


Fig. 7. An example of a well-used measurement sheet used for templating one of the dress ensembles for the "Identity by Design" exhibit.

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proportions, such as depth of waist and hips (No. 11 and No. 15, waist depth and hip depth, on fig. 7) helped to guide the depth of the mannequin support in this exhibit and therefore were noted on the measurement sheet.

Clean, white, 61-cm (24-in.)-wide butcher paper was used to make the dress templates. The width of the paper corresponded to the width of the Ethafoam planks used, making transfer of information a bit easier. The garment was carefully lifted and a piece of the butcher paper was slid underneath. All pencil markings were done with a barrier between pencil and garment.

The shape of the shoulder needed to be established. Most of these dresses were of unstructured construction, so the shoulder angle was one of the clearest definitions of body shape that the viewer would have. Shoulder angle was also crucial to creating a correct hang to the dress, so great care was taken to accurately reproduce it on the template paper. The shoulder area was modeled from the garment with a flexible rule or piece of padded armature wire and traced to the paper.

Once the shoulder angle was traced on the paper, then the rest of the dress's outline was roughly drawn. Approximate vertical centers of the garment were marked at the top and bottom of the paper. Specific areas, such as underarm points, bust points, and neck openings, were noted, as well as particularly delicate or damaged areas and areas where the garment would need specific weight support or the mannequin would require special coverings. Once all pertinent information was noted, the paper template was removed from under the garment. The paper was then folded in half along the top and bottom center marks and reflattened to create a vertical center line. It was then possible to begin to apply measurements that would help determine the size of the Ethafoam blank pieces to cut.

The bust line and the hip area are particular depth determiners, so cross section templates were made for those areas (fig. 8). After a flat measurement of the garment was taken, it was multiplied by two to get the circumference, and then 2 in. were subtracted to allow for padding material. Then, using a flexible ruler or padded armature wire, a shape of that particular area would emerge. For example, a bust line area that measured 46 cm (18 in.) when flat became 92 cm (36 in.) minus 5 cm (2 in.), or 87 cm (34 in.). If this size would fit through the smallest opening in the torso of the dress, a cross section paper template was

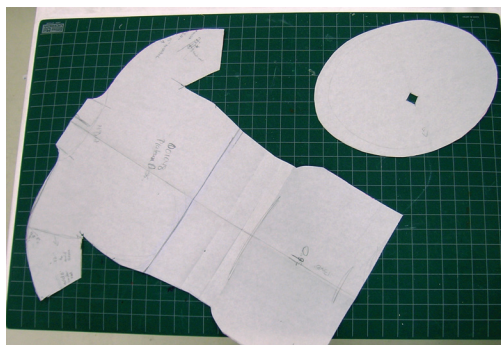


Fig. 8. Example of a paper torso template for a vertical mannequin blank and cross-section template for a hip section disc. Note that shoulder points and vertical center line are marked and that the template has been pleated at the waist to adjust waist height based on planned depth of form.

made to get the depth and width of the mannequin needed at this point. These cross section templates were saved for reuse because many dresses had similar measurements. For example, 87 cm (34 in.), or 46 cm (18 in.) flat, might have turned out to be 36 cm (14 in.) wide and 23 cm (9 in.) deep, depending on the shape needed. The width and depth would then be noted on the template at the appropriate points.

The mannequins needed to be human in shape but still fully supportive of the garment by finding opportunities to create extra support in the slopes of the mannequin wherever possible. For example, the chest and shoulder blade areas sometimes offered an opportunity to create a deeper support shelf by slight exaggeration. The hips could also be slightly expanded to help support the weight of a dress or to create a shelf to support a belt (fig. 10). Measurement adjustment continued to all important points—neck, shoulders, bust, waist, and hips.

Once the new widths were noted on the template at the critical points, the shoulder angle was finalized, and the arm type noted, the template was refolded along the vertical center line and cut out, paper doll style, to create a template with two symmetrical sides as seen in figure 8.

The vertical length of the torso was then shortened by pleat-folding the template as needed along the waist to accommodate for the front to back depth of the mannequin. The amount to shorten was approximately 5 cm (2 in.) for every 20 cm (8 in.) of depth. This calculation was not firm but could be



Fig. 9. Partially carved Ethafoam mannequin demonstrating block construction with planks of various thickness of foam.

adjusted later in the carving if needed. This template was transferred to the Ethafoam for the blank fabrication portion of the mannequin making.

2.3 CREATING THE MANNEQUIN BLANK

The basic mannequin material used was Ethafoam 220, purchased in 2.5-, 5-, and 10-cm (1-, 2-, and 4-in.) thicknesses. Planks 120 by 240 cm (4 by 8 ft.) were cut down to 60- by 140-cm (24- by 54-in.) pieces at the factory to create manageable plank sizes to work with and store. The 60-cm (24-in.)-high blanks were traced from the flat paper torso template to the Ethafoam planks. Desired final depth of the mannequin dictated the thickness of Ethafoam used, but for the most part the core of the mannequin was made up of two sheets of 10-cm (4-in.) thickness with 2.5 or 5 cm (1 or 2 in.) added at bust, belly, or backside as needed (fig. 9). Horizontal Ethafoam discs were used for some of the waist areas to create

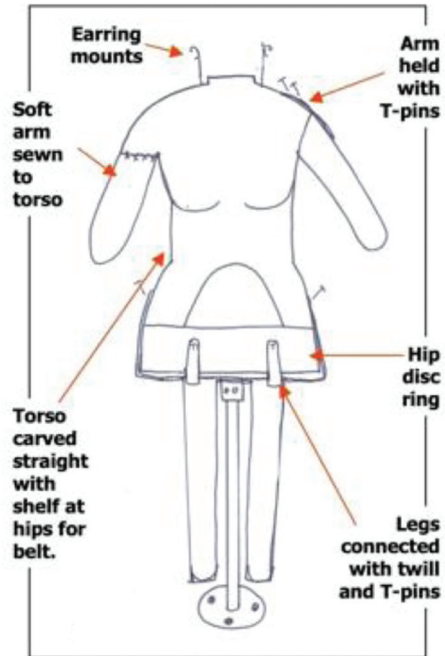


Fig. 10. Illustration of mannequin design showing details of mannequin made for the wool and dentalium shell Sioux dress shown in figure 16. Note that this mannequin implemented both a sewn on pillow arm and a twill arm.

clear carving guides when fit was essential for a belt. Horizontal discs were also used to add longer hip and thigh areas when needed to keep dress skirt areas from collapsing (fig. 10).

Once the templates had been transferred to the Ethafoam, large pieces of foam were cut apart by hand to allow clearance for clean cutting with a 36-cm (14-in.) band saw. Then, the mannequin blank pieces were cut with the band saw along the template lines. After the pieces had been cut, an angled V cut was made along the vertical center line of the two central pieces so that when they were adhered they would create a slot to receive the steel support pole. Then all pieces were heat-welded together using a heat gun.

2.4 FABRICATING THE POLE-AND-RAKE SUPPORT STRUCTURE

The mannequins were all supported with an adjustable steel pole-and-rake structure (LaTouche and Gensheimer 1990s), which is seen in figure 11.

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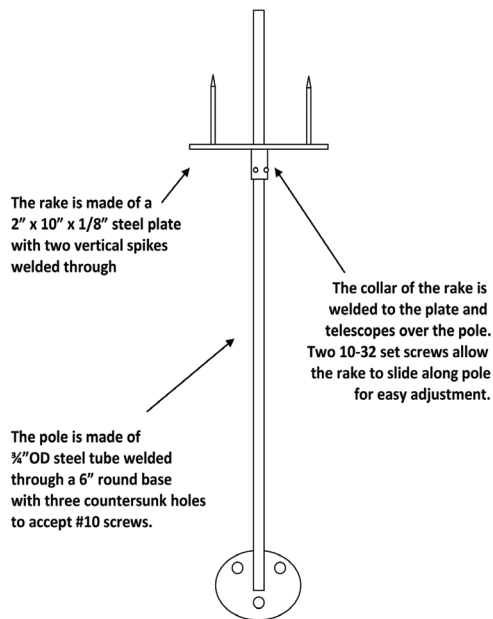


Fig. 11. Illustration of the pole-and-rake stand used for mannequins in the "Identity by Design" exhibit.

The pole acted as the central spine of the mannequin and consisted of a steel tube welded to a circular plate, which allowed easy connection to the case deck. The rake was made of a rectangular steel base and two pointed spikes that were inserted into the mannequin torso with a central tube that telescoped over the pole structure and was secured with two set screws. The telescoping action and set screws allowed subtle adjustment of the height of the mannequin on the pole during dressing and installation. This adjustment was particularly useful in this exhibit for fine-tuning the legs when the fringe of the dresses needed to cover specific areas of the moccasins.

The pole portion had a 15-cm (6-in.)-round by 0.3 cm (1/8-in.)-thick steel plate welded to a 1.9-cm (3/4-in.) (outer diameter) steel tube that was either 120 or 150 cm (48 or 60 in.) tall, depending on the garment requirements. Generally, the pole was welded to the plate so the plate could sit flush on the case deck, but sometimes a pole would be welded through the base, leaving an extra weld area to add strength for particularly heavy, tall, or unbalanced garments.

The rake part of the structure started with a collar tube that telescoped over the pole and secured

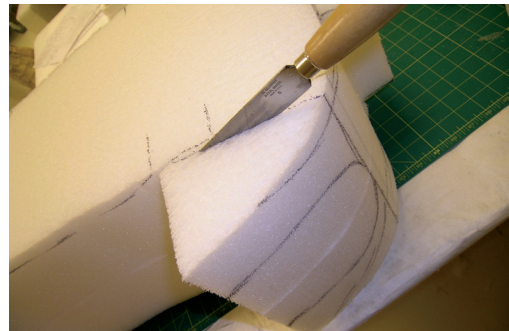


Fig. 12. Beginning cuts on the marked-up Ethafoam mannequin blank.

with two 10-32 set screws. This collar was welded to a 25 by 5 cm (10 by 2 in.) rectangular plate that carried two spikes to stick into the Ethafoam at the bottom of the torso. The telescoping feature of the pole-and-rake system allowed for the pole to become part of the spine of the mannequin and for subtle height adjustment as needed.

2.5 CARVING AND FITTING

Once the mannequin blanks were created and put on their poles, carving could begin. With the measurements taken, the carving became a simple job of refining the rough mannequin blank into a mannequin torso by connecting the anatomical dots. Ceramic or steel knives 10- to 15-cm (4- to 6-in.) long were used for carving the mannequins (fig. 13).

Before carving started, all measurements were double-checked. Shoulder, bust, and shoulder blade points were marked on the front and back of the blank. Neck, arm, and hip shapes were drawn on appropriate areas. In general, carving began by cutting away material from the arm area at the shoulder to make carving easier (fig. 12). The next, very crucial cuts were made to create the shoulder slope by following the points from the neck circle down across the shoulder to the arm circle. Attention was paid to the front chest and back shoulder blade areas. Then, cuts were made from the bottom of the torso up to the underarm to round the mannequin shape. Work started in long, broad faceting cuts, and then the edges of the cuts were rounded down. Finally, the mannequin was smoothed as needed with a Surform tool (fig. 13).

Once the foam was carved, measurements were checked to be 2.5 cm (1 in.) smaller than the



Fig. 13. Some tools used to carve and finish the mannequins. Electric knife sharpener (for steel blades only) at top, lower row (left to right): Surform rasp and replacement blade, burnishing tool for inserting material into Ethafoam (fig. 14), ceramic knife, steel square-edged knife, and steel pottery knife.

garment required (approximately 0.6 cm ($\frac{1}{4}$ in.) on four sides) to allow for a 0.6-cm ($\frac{1}{4}$ -in.) covering of padding and barrier material. If more padding was required, the carved mannequin size would be adjusted as needed. This measurement was especially important in the shoulder and bustline areas because some of the mannequins had to fit through the smallest opening of the dress between the arms. Various strategies were implemented to allow safe dressing of garments on the mannequins. Sometimes, the upper arm or shoulder needed to be cut down to a minimal size. Some torsos had to be cut into multiple pieces and strategies developed to connect them back together to facilitate safe dressing. Measurements were retaken and adjustments made until ready for first fitting. Up until this point, the garment has not left the table.

For the first fitting, a layer of stockinette was stretched over the Ethafoam shape. Then soft Tyvek



Fig. 14. Demonstrating the use of the burnishing tool to insert stockinette into a slit in the Ethafoam.

1443R was draped and pinned over the top to allow for smooth insertion. During this fitting, notes were made on adjustments needed to arm lengths, waist or hip diameters, waist height, and mount connection points. Finish coverings, padding, and undergarment support needs were also noted at this time.

2.6 FINISHING THE MANNEQUINS

Once the fit was correct, the mannequins were covered with additional batting as needed then topped with 0.3-cm ($\frac{1}{8}$ -in.)-thick, polyester needle punch felt with polyester stockinette stretched over the top. Finish fabrics, such as Tyvek, to reduce friction or cotton flannel, fleece, or stockinette to provide friction or padding were added as appropriate. These materials were sometimes stitched on but generally were attached by means of stuffing them into grooves cut into the Ethafoam (Schlichting 1994) (fig. 14). Black Polarfleece was added to the visible areas at the necks, wrists, and sides of the torso.

Many of the dresses also required separate underskirts to keep them from collapsing in at the bottom. These skirts were sewn from Tyvek with one or more of four stiffeners underneath: a layer of thick Polarfleece, 0.6-cm ($\frac{1}{4}$ -in.)-thick needle punch felt, organdy, or a millinery wire hem. The type of underskirt selected depended on the overall weight of the skirt and where the weight of the garment required support. Each underskirt had a twill tape waistband held together with Velcro. The goal of these skirts was not to create a historical silhouette but rather to allow for natural-looking draping without collapsing over time.

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3. MOUNTING SYSTEMS

The mountmaking connections to the mannequins broke into four anatomical areas: legs, waists, arms, and heads. This discussion follows these general anatomical areas of the mannequins from the ground up and shows some of the types of solutions achieved to create the desired aesthetic and support needed.

3.1 THE MOCCASIN AND LEG SYSTEM

For the moccasins and leggings, removable legs were created to aid in deinstallation and packing the moccasins and leggings for travel. They connected securely to the torso of the mannequin at the top of the leg. Although the ensembles would be displayed on open platforms, it was decided not to mechanically secure the feet to the decks. Many of the moccasins had delicate beadwork or quillwork in the foot area where straps would have been required. Just the action of attaching and reattaching straps from venue to venue could have put many of the moccasins at risk of damage. Instead, the feet were weighted in the heels with half-pound weight bags. That, along with felt barrier pads adhered to the platform below the feet, created some friction and a slight illusion of connection to the deck if the feet were to be unintentionally bumped. If pulled harder, the legs would release from the deck but not from the mannequin.

Each moccasin was first outfitted with a custom moccasin insert internal barrier, essentially a Tyvek and felt moccasin-within-a-moccasin that acted as a barrier to any additional stuffing that was needed and helped define the form of the foot and leg (fig. 15a) (Chang 2002). Once the insert barrier was placed inside the moccasin, a pillow stuffed with polyester batting was inserted into the toe of the insert and a half-pound weight bag was inserted into the heel of the foot.

Legs were made from 8-cm (3-in.)-diameter backer rod supplemented as needed with batting of appropriate thickness then covered with stockinette or Tyvek (fig. 15b). The lower heel area of the leg was carved to hold the weight bag in place and to support the heel of the moccasin. The length of the legs was crucial to the illusion of connection. It was cut to a length that fit the leg ensemble snugly between the bottom of the torso and the platform while still leaving enough space for the moccasin to

be set without excessive compression. If the moccasins were tall or had additional leggings attached, they were held onto the leg with a combination of internal friction from the padding and an external twill tape strap closed with Velcro (fig. 15c) so that the bottom edges would not collapse and crush over time. The connection of the legs was made by means of twill tape pushed through the top of the legs in both front/back and side/side directions and held by T-pins (figs. 10, 15d).

3.2 THE BELT AND WAIST SYSTEM

Twenty of the 53 ensembles were dressed with belts. Most of the dresses did not have associated belts, so the curator needed to select pieces from the collection that worked stylistically but did not necessarily fit the dresses well. In addition, most of the belts were extremely fragile, with cracking leather and unusable original buckling mechanisms. Mounts for the belts had to be self-supporting and self-contained because access to the mannequin through the dresses was not possible.

Originally, the staff mountmaker had planned to fabricate the mounts as soft under-belts with an embedded brass structure, a solution that could have been time-consuming to fabricate but minimally invasive to the belts. After conversations with NMAI conservators, a collaborative, conservation-based series of solutions was implemented by the conservators for the mounts, using Vivak, Mylar, and Velcro (Cullen Cobb et al. 2008).

One example can be found in this Lakota dress ensemble (fig. 16). This belt posed a particular challenge because of the weight of the knife sheath and belt drop (the long portion of the belt that hangs in front), which caused any flexible mount solutions to distort and pull the belt open. The tongue was worn and abraded so it could not be used to connect the belt together. The mount attached directly to the underside of the belt and drop, holding the whole assembly together. The connection was made rigid by attaching a thin, curved Vivak sheet behind the drop through existing holes with artificial sinew that keyed to felt "buttons" in the back. A Mylar sheet barrier lined the inside of the belt to finish this "inner belt" and the whole assemblage closed with a Velcro overlap. Painted Tyvek strips with Velcro closure loops stabilized the belt on the mount and inside the knife sheath's loop (fig. 17).



Fig. 15. Steps involved in making the moccasin and legging mounts. A, Tyvek and needlepunch felt moccasin insert with toe pillow and half pound heel weight bag in foreground. B, Moccasin with backer rod leg inserted. Note that with the weight bag set in the heel, the leg can stand on its own temporarily. C, Showing twill tape and Velcro strap (with intentionally contrasting stitching) holding legging in place against soft cushion on leg. D, Twill tape inserted through the top of the leg for attachment to the Ethafoam torso on site.

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Fig. 16. Sioux saved-list blue wool dress with harness leather belt, knife sheath, and drop and beaded leggings and moccasins. Courtesy of the National Museum of the American Indian, Smithsonian Institution (02/6425 dress, 21/1916 belt, 13/6496 ear ornaments, 13/6497 necklace, 25/0107 moccasins and 18/4293 leggings). Photo by NMAI Photo Services Staff.

3.3 THE PURSE AND ARM SYSTEM

A number of ensembles gave the illusion that purses were being carried in hands. The desired aesthetic was to place the object in the appropriate area of the hand without actually having a hand there. Because of the weight of the purse, this required making the arm itself into part of the mount structure.

One example of this was a mount for a purse for the hide and beadwork Sioux style “Give Away Horses” dress ensemble made by Joyce, Juanita, and Jessica Growing Thunder (figs. 18, 19). The mount was made of 0.6-cm ($\frac{1}{4}$ -in.)-thick acrylic and brass, which supported the back of the purse and carried its weight. Inside the bag was a piece of Dibond, padded to fit snugly. A padded top clip slid into place over the bag’s insert and was screwed into position on the back of the mount, sandwiching the bag into a slightly compressed locked position. Bent brass

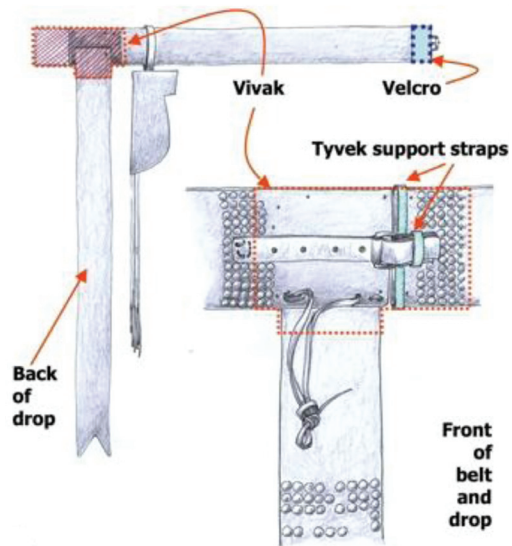


Fig. 17. Illustration of the belt and mounting system for the belt shown in figure 16. Courtesy of Kim Cullen Cobb.

tabs supplemented the support at the bottom of the bag. The handle of the purse was tied through holes in the brass handle of the mount with embroidery floss. A heavy washer/spacer was incorporated into the handle support to connect to the threaded rod, extending from the wrist to be held in place with a cap nut (fig. 19).

At installation, a hide-colored cotton fabric was inserted over the nut at the wrist to help camouflage the area by blending in with the fringe of the dress. The cap nut was also painted with acrylic paints at installation to guide the viewer’s eye away from any metal elements.

3.4 THE CROWN AND HEAD SYSTEM

In this exhibit, none of the mannequins had heads, but some of the ensembles in the contemporary powwow section involved incorporating multiple mounts in the head area. The challenge was to balance visual accuracy with unobtrusive mounts that would be seen from all sides.

In the example shown here from a powwow dress ensemble made by Keri Jhane Meyers and Alice Jones Littleman (figs. 1, 20), the ensemble included a crown, earrings, a choker, necklace, and hair ties. The mount

attachment strategy was simplified by putting only the crown and earrings on brass mounts. The brass stems that attached to and extended from the neck of the mannequin were to create an abstracted face outline that would give a general idea of object placement and anatomy without delving into portraiture (figs. 1, 20). These stems were attached to the mannequin by inserting them into tubes in the neck and locking them in place with set screws.

The crown mount was a padded brass strap ring with four bent tabs to support the weight of the piece around its inner circumference. Brass was chosen as the material for this support ring over clear acrylic or Ethafoam because the curator had requested an open support for the crown while still covering the unfinished interior stitching on the interior band of the crown.

The earring mounts were two-piece spider mounts, connected by a screw mechanism. The mounts fit around the earrings in a kind of a two-part claw. The stem of the mount, which was made from 4–40 threaded brass rod, slid through a clear hole “piercing” in the neck stem and was tightened with a washer and nut, holding the earring securely and unobtrusively (fig. 21).

It was decided to not introduce the element of hair into the mannequin, so the hair ties required a creative solution. Foam backer rods 1.2 cm (a half-inch) in diameter were covered with black polyester fleece and then were draped over the neck of the mannequin to give the illusion of two “braids.” The hair ties were attached to the “braids” in a culturally appropriate way by the curator. The other elements of the head and neck area, the choker and necklace, were supported by the mannequin neck and stitched into place.

4. DISCUSSION

The systems introduced in this article demonstrate the delicate balance between object safety and display requirement that is needed to create mounts for any exhibit. Inevitably, some solutions work more successfully than others, and all are continuing works in progress.

For example, the T-style arm structure offered a particular challenge in the balancing of handling risk with anatomical accuracy and full garment support. Because the mannequin arm needed to slide through



Fig. 18. Arm structure and purse mount for the Assiniboine “Give Away Horses” dress. Note the extra twill tape support all along the length of the arm and at the shoulder to support the extra weight of the purse and its mount. Courtesy of the National Museum of the American Indian, Smithsonian Institution (26/5818). Photo by NMAI Photo Services Staff.



Fig. 19. Views of the purse for the “Give Away Horses” ensemble from the back and installed.

the side of the garment to dress the mannequin, the arm had to be made as small as possible to avoid stressing the side seam. However, reducing the diameter of the arm necessarily minimized the area of the collarbone and sternum areas that are also important for full support of a garment like this. To remedy this, for several dresses, additional support pads were made to insert into the collarbone area once the dress was

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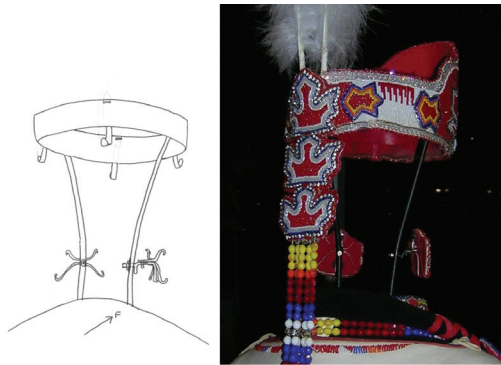


Fig. 20. Mounting structure for the crown and earrings for the Niuam (Comanche) dress ensemble. The crown mount held the piece at four tabs and was additionally held by polyethylene straps to avoid removal. Courtesy of the National Museum of the American Indian, Smithsonian Institution (26/5713).

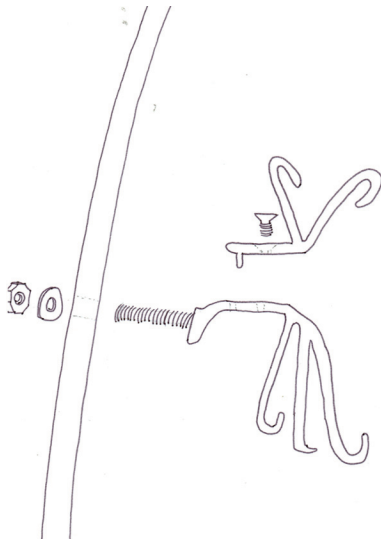


Fig. 21. Mount detail for earrings for the Niuam (Comanche) dress ensemble. The earring mounts clasped the object and were held together with a 2-56 screw. The mount was attached to the “ear” of the mount by means of a washer and nut over a 4-40 threaded rod. Courtesy of the National Museum of the American Indian, Smithsonian Institution (26/5713).

on its mannequin. Also, solid connection between the T arm and the lower torso of the mannequin was crucial to guarantee the dress was fully supported through the entire “spine” and that the heavy weight at the top of the piece could not twist or collapse the mannequin. This area was made more secure by creating a V-shaped “key” so the arm piece could fit solidly into the torso (fig. 3).

Another experimental solution was demonstrated in the aluminum keyed type of arm. This type represents an ongoing quest for a solid yet adjustable arm attachment that connects easily and locks in place securely without unduly stressing the shoulder area of the garment. It was found that mating the arm and shoulder tubes of this type of arm still required a fair amount of garment manipulation and that it was still fairly difficult to lock the arms in place when the mountmaker could not see inside the arm of the garment. The search for the perfect mannequin arm connection system for articulated poses continues.

The twill arms, in contrast, worked extremely well for supporting the arms of dresses in this exhibit that did not require forward articulation. The ease of installation and adjustability of the system proved functional and cost-effective.

The leg system developed for this exhibit also proved to be a successful technique. The removable nature of these supports allowed for the moccasins and leggings to be dressed independently and ahead of the installation. Because the fabrication work could be performed separately from the torso of the mannequin, delegating this work was possible, which helped to shorten the overall calendar work time. The flexible nature of their twill tape connections allowed for a more natural placement of the feet and easy last-minute final pose adjustments. In addition, once the T-pins were removed and the twill tape released, the moccasins could remain dressed on their legs for packing, which made reinstallation much less complicated at later venues. The moccasin inserts and toe pillows were also used as internal storage mounts once the objects were off exhibit.

5. CONCLUSION

The dress and accessory ensembles in the “Identity by Design: Tradition, Change and Celebration in Native Women’s Dresses” exhibit at the NMAI offered many

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opportunities for experimentation in the preparation of the mannequins and the mounting systems.

Making custom mannequins is sometimes seen as an expensive and time-consuming task, but using the techniques described in this article, the mannequins in this exhibit averaged a materials cost of \$200 and two days of fabrication time each. The mannequin fabrication approaches and arm styles could be grouped in material and time-efficient ways by carefully analyzing the support and display needs of the garments. Systems were developed that allowed for collaboration and delegation of duties. Creative ways to discreetly and safely support multiple accessories were found. By first analyzing the overall scope of work then honing the techniques and tasks, ways were found to streamline the process.

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