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Boxing the 'Big Huge': A Preventive Conservation Conundrum

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TRADITIONAL HOUSING options for extremely heavy books or acutely oversized three- dimensional library objects can prove inadequate. Cloth-covered drop-back boxes add undesirable weight to an already unwieldy package while corrugated paperboard phased boxes are insufficiently durable to provide long-term protection for their ungainly contents. Combining Peter Waters' principles of phased conservation (and their attendant benefits)[1] with advances in museum housing design for three-dimensional objects championed by Carolyn Rose and Amparo Torres,[2] and linking these ideas to testing use of corrugated polypropylene sheets (referred to as Coroplast throughout this article) conducted by the Canadian Conservation Institute (CCI),[3] staff at the University of Utah's Marriott Library developed a useful housing option for the library's overly heavy ledger books and unconventionally shaped, three dimensional objects.

Advantages derived from using Coroplast as a material for housing gargantuan library material include its being chemically inert, lightweight yet rigid and easily manipulated using simple hand tools. While prefabricated Coroplast boxes are currently available from commercial archival suppliers in standardized sizes for housing documents, maps and textiles,[4] custom fitting Coroplast boxes have not been described in the library conservation literature. A model is defined herein for consideration as a conservation option.

Corrugated Polypropylene Sheets

The Coroplast Inc. began operation in 1973 as a wholesale dealer of corrugated plastics based in Montreal that distributed product throughout Canada. The firm began manufacturing Coroplast in November, 1975 with the opening of its first plant in Granby, Quebec. Subsequently, a second manufacturing plant was opened in July, 1985 in Dallas, Texas, a third in Vanceburg, Kentucky in 2001, and acquisition of the plastic corrugated division of Spartech (Cornwall, Ontario) followed in 2005. The company's web site indicates that today Coroplast is "the leading manufacturer of corrugated plastic sheets for the sign and returnable packaging markets in North America."

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Figure 1: Vauna Gross posing next to her Coroplast box for a freestanding 7 ft. 8 in. (2.33 m) scale model of a NASA Saturn V Moon rocket complete with handles, padded earthquake bracing, and straps to secure the box to a structural column. (Photo credit: Hunt, Silverman)

The material is known by various trade names: Coroplast®, Cor-X and Hi-Core in North America; Correx in the United Kingdom; and Fluteboard and Corflute in Australia. According to the manufactures' literature, Coroplast® Archival grade is "a chemically inert, extremely durable polypropylene copolymer, extruded twinwall fluted plastic sheet free from additives such as coloring agents, antistatic and ultraviolet inhibitors." The company states it is "suitable for backing, mounting and fabricating containment enclosures" and represents "A superior substrate for long-term use with no out-gassing. It is resistant to water, oils and solvents at room temperatures." The only caveat mentioned in the product description is "Coroplast Archival is not recommended for any application in which it is exposed to high amounts of UV radiation, including all uses outdoors."[6]

Coroplast is a chemically inert polyolefin copolymer; the sheet has "a NIL pH factor."[7] It is structurally similar to corrugated cardboard, but instead of requiring an adhesive to join the outer membrane to the internal flutes or ribs, the twin-wall plastic sheeting is extruded as a single unit, eliminating delamination issues. The copolymer resin retains "the ability to be flexed an unlimited number of times without breaking" a characteristic the manufacture refers to as "a living hinge."[8]

Coroplast is commonly sold in large sheets (8 feet x 4 feet / 2.42 m x 1.21 m) in thicknesses ranging from 2 to 6 mm (0.07 to 0.23 inches). Both outer surfaces of the sheet are treated electrostatically with corona discharge to allow them to accept certain types of inks and adhesives. Scott Williams believes that "because it is made of solid polyolefin and many tests for extractables and odors in other applications such as food and pharmaceutical have shown low levels, by analogy, these products should be suitable for conservation."[9] Based on "spectroscopic analysis of a small number of degraded samples to determine the cause of their degradation," he cautions that Coroplast should not be exposed to ultraviolet (UV) light sources such as fluorescent tubes or daylight, or to cleaning solutions, because UV radiation and certain oxidizing chemicals will cause the polymer to break down.[10]

While most archival products are purposely free of additives or colorants, Coroplast marketed as "archival" is clear and contains no UV filtration or oxidation stabilizers. This lack of pigmentation increases the plastic's susceptibility to photodegradation and as a result will accelerate its deterioration. As there has been no evidence that UV filtration or oxidation stabilizers migrate or cause damage to objects, Williams recommends use of pigmented Coroplast. He believes black may

be the most stable of the available options because it absorbs UV radiation and prevents photooxidation of the plastic.[11] Canadian Conservation Institute (CCI) Senior Conservation Scientist (Chemist), Scott Williams, describes Coroplast as a material CCI has recommended for museum artifact housing and library exhibit supports since 1993.[12] He notes that some people have argued that "white is better because it is easier to see dirt and bugs, and it makes a room brighter,"[13] and concedes these may be legitimate conservation considerations, but the stability of the material inside the boxes is improved by using a color that blocks UV.

Custom Housing Oversized Objects

A venerable problem in library conservation is how to house objects so heavy they are unwieldy to lift or so large they do not conform to common dimensions of box-making materials (e.g., normal sheets of binder's board or bolts of book cloth). While the benefits of housing are universally acknowledged—protection in storage and transport from abrasion, light, dirt, changes in temperature and relative humidity, as well as a shield from potential water damage—some objects seem to defy normal boxing options. Examples of longstanding housing problems at the Marriott Library include several 30 pound (13.6 kg) manual typewriters originally belonging to American historian, novelist and Pulitzer Prize winner, Wallace Stegner, and a collection of unique, freestanding scale model rockets produced by the National Aeronautics and Space Administration (NASA) ranging in height from 8 inches (20.3 cm) to the towering 7 feet 8 inches (2.33 m) Saturn V Moon rocket (Figure 1).

Given the fragility or sheer dead weight of these objects, an important consideration in fabricating their housing is how they are to be lifted from and returned to their boxes. For smaller objects, the box can be constructed from a single sheet of Coroplast relying on a standard clamshell design (Figure 2). With overlarge or very heavy pieces, the Lid and the Base can be formed from two separate Coroplast sheets. For these cumbersome objects, one option employs a Base Tray with rigid sidewalls permanently affixed with nylon snap rivets.[14] Another approach relies on resealable sidewalls that close magnetically. This is achieved by attaching magnetic strips to the Coroplast walls with double-sided tape[15] so the walls can be opened flat to provide unencumbered access to the object without having to lift it from the Base Tray.

Another approach relies on resealable sidewalls that close magnetically.

Figure 2: Standard clamshell box design applied to a single sheet Coroplast box. (Photo credit: Hunt)

Housing Oversized Books

A critical breakthrough realized with Coroplast is this material is strong enough to provide an answer for housing oversized and extremely heavy bound ledger books. Nineteenth and early twentieth century ledger books can exceed 41 inches (104 cm) in length and weigh in excess of 35 pounds (15.8 kg) (Figure 3). Lacking a reasonable housing option to protect these important corporate personnel and financial records, the Marriott Library had, in fact for years, stored them unprotected on baked enamel shelving in an offsite storage facility.

Their unwieldy size and weight necessitated a design that provided both a durable transport unit to and from offsite storage and a way to minimize the need to lift the book from its box to gain access. The solution proved

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Figure 3: Example of an oversized, early twentieth century post-bound ledger book prior to boxing. (Photo credit: Galyean)

to be custom fitting, lightweight, two-part Coroplast boxes as described above, with the sidewalls joined with magnetic strips to encourage intermittent access.

Two-piece Coroplast Box Construction

Requisite materials for housing oversized ledger books include 4 mm (0.15 inch) thick Coroplast, magnetic strips 0.75 inch (1.9 cm) wide and nylon snap rivets. Necessary tools include: a standard 18 inch (0.46 m) steel ruler, 48 inch (1.21 m) beveled steel straight edge, scalpel, awl, bone folder and heat gun with a 450° F (232 C) setting. Because Coroplast has sharp edges when cut, it is suggested the corners of each piece be shaped with a desktop corner rounder or scissors.

The two-piece Coroplast box is made according to the pattern on Figure 4. Measure the object's dimensions—length, width and height—and apply the values to the formula for the Base Tray. Mark off and score the lines for the box walls, cut out the corner material to accommodate folding and fold and heat the walls along the scored lines. If desired, attach magnetic strips to the wall flaps to form a closing mechanism (Figure 5).

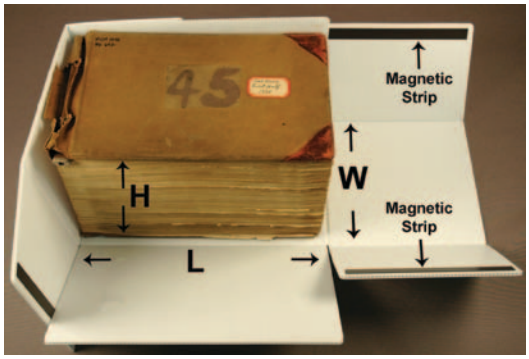

Figure 5: Clarification of Length (L), width (W) and height (H) in relation to an oversized ledger book. Magnetic closures allow the walls of the base tray to open completely to provide easy, unobstructed access. (Photo credit: Hunt)

Similarly, determine the Lid dimensions by measuring the completed Base Tray and calculate the values using the Lid formula (Figure 6). Secure the Lid walls with 7/16 inch (0.325 cm) nylon snap rivets.[16]

Considerations

Coroplast sheets 4 mm (0.15 inch) thick can be readily manipulated and the creases will hold their shape if the plastic is softened slightly by the heated airstream from a heat gun. Creasing and folding narrow sidewalls (less than 2.5 inches / 6 cm) is sufficiently difficult, however, that thinner Coroplast (0.07 inch / 2 mm thick) should be considered as an alternative because it proves to be more malleable.

The Resources Subcommittee (Conservation Committee) of the Society for the Preservation of Natural History Collections of the Royal Ontario Museum notes that "channels in Coroplast may provide [a] habitat for insects."[17] Similar arguments could be made for any corrugated paperboard as well and this essential question should be addressed by monitoring for pests in collection storage.[18] Miranda Martin noted in a posting on the Conservation DistList that Coroplast boxes "melted onto their contents" during a controlled fire at a disaster response workshop in 2000 called "Burn Baby Burn."[19] Again, all plastics used for housing library collections, including

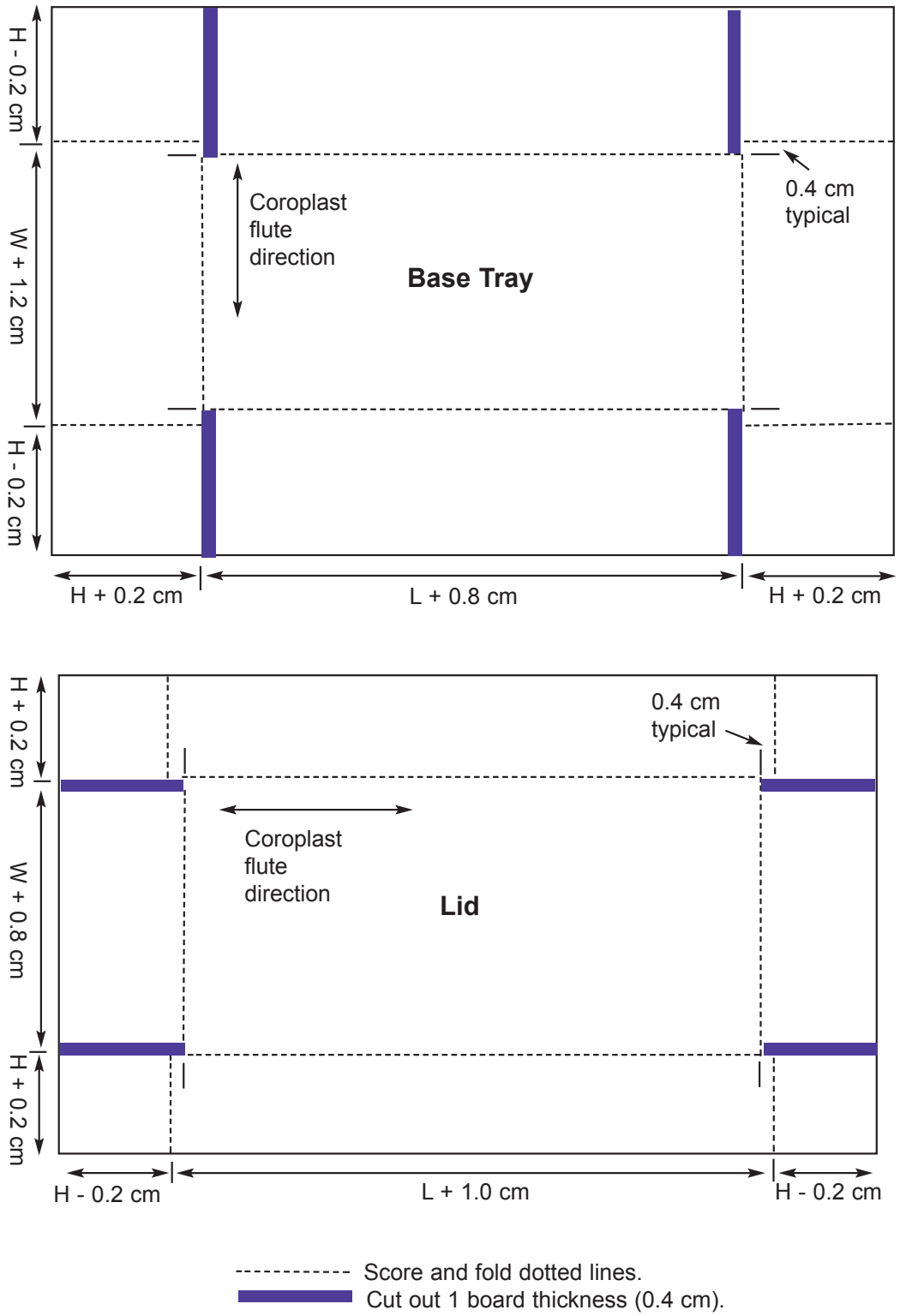

Figure 4: Schematic drawing of a two-piece Coroplast box including scoring, folding and cutting instructions for the base tray and lid. The base tray measurements plus (+) or minus (-) are added to or subtracted from the length (L),width (W) and height (H) dimensions of the object. The lid measurements are added to or subtracted from dimensions of the completed base tray. (Drawing and Photo credit: Hunt)

Scott Williams at CCI conservatively expects Coroplast boxes to have a shelf life of 10 years.

polyester encapsulations, are equally likely to melt in a fire. Appropriate precautions—adequate smoke detectors and fire suppression systems to protect institutional collections are critical, but this observation should be weighed against Coroplast's ability to shed water which represents a relatively common problem in many storage facilities.

Finally, awareness of institutional relative humidity and airflow conditions should precede a decision to use plastics for housing collections. A direct observation following Hurricane Katrina was that plastic enclosures tended to restrict airflow to a greater degree than cellulose enclosures. Given the same water activity in two identical substrates the risk of mold growth may be greater inside a plastic enclosure than a paperboard one whether inside a tropical storage facility where environmental controls are lacking or because of summer equipment failure in a heating, ventilating and air conditioning (HVAC) system.[20]

Unlike molded Tupperware containers, the box design described above includes a loose fitting top and is made by folding sheets of Coroplast such that the four corner seams will admit water should the box become submerged. In the case of water ingress caused by a culinary pipe leak, engaged fire suppression system, or firemen's hoses, however, the box design will shed water far better than a paper-board box. Because the design requires that all four corner seams be slit to the base, it is possible that standing water on library shelving could wick into the box at the base. To remedy this risk, a one-layer Coroplast lift should be included in the bottom of each box. However, as with all disaster recoveries, any boxed material in the affected area would need to be removed from its protective enclosure and checked for dampness following the event.

Benefits

Custom Coroplast boxes can be very cost efficient to produce once the practitioner moves beyond the labor intensive design process. With experience, a custom Coroplast box takes only about an hour to make (compared with four hours to build a comparable cloth-covered drop-back box). Given differences in hourly salaries and box sizes, the average cost to house the Marriott Library's collection of 360 ledger books averaged approximately $20.00 USD (15.0281 EUR) per box, including both labor and raw materials.

Scott Williams at CCI conservatively expects Coroplast boxes to have a shelf life of 10 years. He made this prediction knowing, however, that CCI currently has boxes on its shelves that remain in excellent condition after 20 years or more.[21] As for longevity, it should be remembered that standard cloth and board drop-back boxes also break down with steady use, especially when they are oversized.

Conclusion

The benefits of adequate housing are reflected in the Heritage Health Index Report which states, "Storage is a critical component of preventive collections care because, with few exceptions, it is the environment in which collections are held much of the time."[22] For purposes of making custom-fitting boxes for overly large books and particularly heavy library objects, the authors found Coroplast, with its light-weight and water resistant properties, ease of manipulation, and affordability, offers a technical solution for material that may have previously remained unhoused for lack of a workable solution.

Figure 6: Completed two-piece Coroplast box for an oversized ledger book showing nylon snap rivets used to mechanically fasten the walls of the lid. (Photo credit: Hunt)

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4. See for example, Hollinger Metal Edge, http://www.hollingermetaledge.com, search term "polypropylene box."

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8. *Ibid.*

9. Email communication with Scott Williams, Senior Conservation Scientist (Chemist), Canadian Conservation Institute, 11 October 2011.

10. *Ibid.*

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12. See for example: Debra Daly Hartin, "Backing Boards for Paintings on Canvas," CCI Notes 10/10 (1993), retrieved from the World Wide Web 2 October 2011: http://www.cci-icc.gc.ca/crc/notes/html/10-10-eng.aspx ; "Display Methods for Books," CCI Notes 11/8 (1994), retrieved from the World Wide Web 2 October 2011: http://www.cci-icc.gc.ca/crc/notes/html/11-8-eng.aspx ; and, Maria Esteva, "Corrugated Polypropylene: Properties and its Use in Conservation," *The Cochineal: The Forum for Student Work at the Kilgarlin Center for the Preservation of the Cultural Record. University of Texas at Austin* (Fall, 2001), retrieved from the

World Wide Web 2 October 2011: http:// www.ischool.utexas.edu/~cochinea/html-paper/m-esteva-01-polypropylene.html.

13. Email communications with Scott Williams, Senior Conservation Scientist (Chemist), Canadian Conservation Institute 20 June 2011 and 16 March 2012.

14. Scott Williams has seen "boxes bonded with mechanical fasteners like rivets, Chicago screws, hot melt glue squeezed into channels, ribbons, and tabs; and adhesives like double sided pressure sensitive adhesive (PSA) tapes and glues, including hot melts on intact surfaces (not squeezed into channels). The only failures of load bearing bonds have been with the adhesive methods. Double-sided tapes and hot melts do not adhere well to low-surface energy surfaces such as polypropylene. Only adhesives recommended by the suppliers should be used. PSA tapes and adhesive should never be used for load-bearing bonds because the PSA generally has low shear strength and flows or creeps when stressed." Email communication with Scott Williams, Senior Conservation Scientist (Chemist), Canadian Conservation Institute, 11 October 2011.

15. Magnetic strips are available in 0.75- 1.5 in. (1.9-3.2 cm) widths and can be purchased without PSA attached to one side of the magnet. See, for example, the U.S. Adams Magnetic Products http://www.adamsmagnetic.com/ . The recommended adhesive for attaching the magnet to the Coroplast walls is 3M™ Double Coated Tape 415, a 4.0 mil double coated polyester with acrylic adhesive 400 lined to a 4.0 mil 60 lb densified kraft paper liner. This tape is specified for archival applications in Library of Congress, Preservation Office, *Polyester Film Encapsulation* (Washington, D.C.: Library of Congress, 1980): 4.

16. Nylon Snap Rivets consist of a male and a female component joined with simple hand pressure. See for example in the U.S., KR TYPE 1 (0.325 in. / 0.825 cm) from King Richard Company http://www.kingrichardco.com/SnapRivets.htm.

17. Helen Coxon and Janet Waddington (compilers), *Supplies and Materials for Museums Collections (v. Canada*) (n.d.): 7, retrieved from the World Wide Web 2 October 2011: http://www.docstoc.com/docs/41916913 Supplies-and-Materials-for-Museum-Collections-_v-Canada_.

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