STRUT YOUR STUFF: THE USE OF STRUT CHANNEL AS A SUPPORT SYSTEM FOR OBJECTS

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The Naval History and Heritage Command's newly formed Conservation Branch has developed several means of supporting heavy objects, such as a ship's bells, using assemblies constructed from the widely available strut channel and accessories.

KEYWORDS: Strut channel, Unistrut, Superstrut, Bells, Ship's bell, Mount, Pallet, Naval History and Heritage Command, Navy

1. INTRODUCTION

The Conservation Branch of the Naval History and Heritage Command (NHHC), founded in September 2015, is currently in the process of developing its laboratory and facilities within the NHHC Collection Management Facility in Richmond, Virginia. As equipment and resources are procured during this initial setup phase, the Conservation Branch has developed some workarounds and what we believe are novel methods for supporting objects using a strut channel.

The strut channel, also called a metal framing channel, is a widely available “standardized formed structural system” (Wikipedia. s.vv. “Strut channel”) available in variations, including lengths up to 20 ft. with different permutations of perforations or slots. It is available in several electroplated galvanized finishes, electrogalvanized as well as stainless steel alloys. One of its great strengths is that components are assembled with standard threaded fasteners to make weldless connections with simple tools, such as a hacksaw and wrench. It is commonly used in industrial spaces to support electrical wiring, network cables, and piping and is known by several brand names, including Unistrut and Superstrut. It can be made into strong shapes using easily available connector parts of various orientations.

2. TILTING APPARATUS

Accessing the underside or interior of heavy objects can be harrowing; positioning and keeping a heavy object securely in a desired orientation can be difficult. Such is the case for many of the larger, heavier ship's bells in the NHHC collection, which are smooth, rounded shapes with few places to grip safely. Underside access may be needed to assess a bell's interior condition (e.g., checking for the presence of paints containing lead pigments), to assess or remove the bell's clapper mechanism, or to install hanging hardware.

Rather than relying on rope or strap rigging methods to attempt accessing the interior of moderately sized bells, I devised a tilting rig constructed from sections of a strut channel to tilt such bells to a 90° orientation, thereby allowing such access.

This contraption acts as a second-order lever. For example, when tilting a bell weighing 240 lbs. ("W") with an opening diameter of 20 in. ("X") and using standard 60-in. lengths of strut channel ("L"), we would need to provide only 80 lbs. of force ("F"), as demonstrated in this equation:

\[ F \times L = W \times X \]
\[ F = \frac{(W \times X)}{L} \]

E.g., \[ F = \frac{(240 \text{ lbs.} \times 20 \text{ in.})}{60 \text{ in.}} = 80 \text{ lbs. of force} \]
This threefold mechanical advantage is preferable to risking the physical safety of the person attempting to lift or tilt the bell’s entire weight of 240 lbs. or risk damaging the object by relying on a concentrated area of the object’s rim as the tipping point.

The actual assembly of this rig was accomplished using many of the components depicted in figure 2. Standard 60-in. lengths of strut channel were joined with 90° strut corners to serve as the tipping point, with the ends of length mitered so that there could be two bolts through each length into this corner component. Flat corner brackets and four-hole tee brackets were used to attach the cross-braces.

To construct the rig around an actual object, I started by prefabricating the base section, with the lengths of strut channel spaced at a distance wide enough to support the object as well as allow underside access upon completion of the tilt. The outermost cross-brace was left off at this point so that this prefabricated base assembly would be able to slide under the bell unencumbered, as the bell was elevated slightly with wooden cribbing at its center to accommodate the rail-like lengths of the base section. I slid the preassembled base section under the object and transferred the object's weight to the strut channel rails of
this base by removing the wood cribbing. Pieces of cut cardboard tube and blue board were used to protect the bell’s rim from direct contact with the strut channel lengths.

The outermost cross-brace could then be applied to the base section, as depicted in figure 3. This was followed by attaching the two upright lengths of strut channel and both of the cross-braces. The upper cross-brace was positioned at a height just above the head of the bell so that two cantilevered sections of strut channel could be attached to the brace around the bell’s topmost extension, thereby preventing the bell from moving along the y-axis of the rig. Cardboard edge protectors and thick polyethylene sheeting were used to protect the surface of the copper alloy bell from these steel strut channel extensions.

The contoured gap between the back of the bell and the uprights was blocked with enough material to fill the space and help support the object when tilted, such as sections of wooden cribbing and wedges as
well as polyethylene foam along the bell’s surface at the rear. Ratchet-strapping ensured that there was no lateral movement.

Once this rig was fully assembled and the object was fully secured, the bell was tilted, with force applied to the lengths of strut. Just before reaching the tipping point, a second person guided the bell down to its new orientation by carefully pulling on the strut channel lengths that were originally upright. Once in its final position, I had the option of applying weights to the strut channel lengths that were horizontal for an added sense of security. The underside and interior of the bell were then accessible and relevant condition issues were addressed.

3. MOUNTING: A CASE STUDY

The Conservation Branch was asked to develop a storage solution for a badly cracked, 135-lb. ship’s bell from the USS Rainier (AE-5; Lassen-class ammunition ship).

Typically, bells in the collection are stored by strapping them to a pallet, either above the waist or at the head. With this bell, we feared that strapping may put additional stress on the crack and risk propagating it, as illustrated in figure 5.

As an alternative to strapping, I proposed creating an interior column to provide support to the bell on the underside/interior of the bell. Although I first considered using a square steel tube (i.e., hollow structural
To achieve this, I realized that it would require laborious modifications. Additionally, we did not have access to welding equipment. Instead, I chose a component known as a “post base,” which is designed for use with a strut channel and secures it in a vertical orientation perpendicular to this base.

Strut channel column load data provided by the manufacturer indicate that the length needed to support this particular bell, a length between 12 in. and 18 in., would be able to support column loads on the order of 10,000 lbs. (Thomas & Betts 2015). These column loads already incorporate safety factors but are clearly sufficient for a bell of this weight.

I sought a pallet as a surface upon which to attach the post base and found a 24-in. square high-density polyethylene (HDPE) pallet manufactured by Orbis, which is closer to the diameter of this bell and preferable to the larger standard-size pallet, 48 in. × 40 in. I drilled through the HDPE pallet and used bolts, washers, and nuts to secure the post base to it (fig. 6).
I installed a modified coupling nut through the hole in the bell’s head and secured it with a bushing and set screws, as pictured in figure 7. Several washers and isolating layers were added to protect the interior paint layers as well as the bell metal surfaces.

The added benefit of this threaded assembly attached to the bell was that it could be used not only to secure the bell to the mount at the final step but could also be used to lift the bell onto the column in the first place. We lifted it by using a shouldered machinery eye bolt in the coupling nut assembly on the bell in conjunction with a chain hoist and gantry.

Finally, once the bell was in place on the mount, I removed the lifting eye bolt and passed a longer bolt through the threaded assembly attached to the bell and into the second coupling nut that was secured earlier within the strut channel column.
Although more of the bell’s surface area is currently supported with the threaded assembly washers (relative to the surface area of the rim’s edge), the bottom of the supporting post base caused deflection in the HDPE pallet. This deflection occurred over the course of several weeks as we waited for the rim-supporting polypropylene shims, brand name “Wobble Wedges,” to arrive. Fortunately, those shims worked well to distribute some of the weight at the rim and to alleviate most of the HDPE pallet deflection. However, such deflection may not have occurred in the first place if the shims had been used soon after mounting the bell on the strut channel column.

4. CONCLUSION

It is hoped that these strut channel systems will prove useful to conservators and others tasked with collections care. The affordability, ubiquity of component parts, and ease of assembly make strut channel systems a viable and attractive option for those in need of customizable solutions within the confines of limited resources. We will continue to develop strut channels for other applications and look forward to the adaptations made by others for varied collections materials.

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REFERENCES


FURTHER READING


SOURCES OF MATERIALS

Superstrut, 12-Gauge Electrogalvanized Half Slot Steel Strut Channel, Strut Channel Connectors, and Threaded Components
The Home Depot
12300 Jefferson Davis Hwy.
Chester, VA 23831
http://www.homedepot.com

Post Base, Morris Products 17454 Single Channel, 4 Hole, Square
Morris Products
53 Carey Rd.
Queensbury, NY 12804
http://www.morrisproducts.com

24 × 24 Modular Pop Pallet, HDPE
ORBIS Global Headquarters
1055 Corporate Center Dr.
Oconomowoc, WI 53066
800-890-7292
info@orbiscorporation.com

Wobble Wedges, Hard, Natural [Color], Polypropylene
PO Box 18144
Boulder, CO 80308
http://www.wobblewedges.com

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