

Tips & Tactics

Case Study

Elaborate tower crafted to house historic clock

A metalsmith, architect, and clock specialist collaborate on 30-foot Victorian clock tower.

The Victorian tower was designed and built to display a historic clock in the collection of the Sanfilippo Foundation, Barrington Hills, IL.

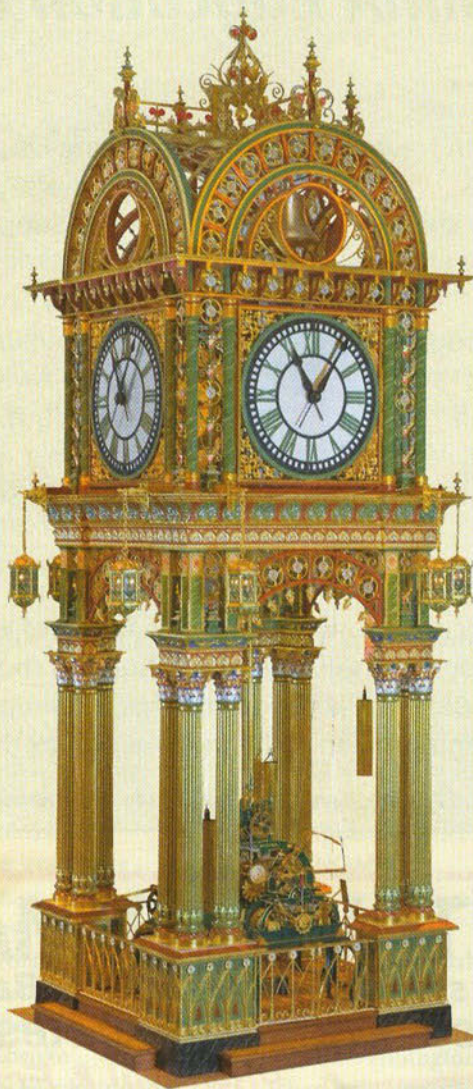
Large mechanical gravity-driven clocks of this kind were impressive public symbols and instruments of civic order prevalent throughout Europe in the 14th–16th centuries. These huge, costly public clocks were often located in the town center, usually in the towers or turrets of large significant buildings for maximum audibility and visibility. The first tower clock in America was mounted in Boston in 1668.

By the mid-19th century, tower clocks were mass-produced in the U.S. and installed in thousands of towns throughout the country in courthouses, churches, city halls, schools, and other private and public buildings.

In the early 20th century, many of them were destroyed or discarded when the complex clockworks of gears, pulleys, and weights were replaced with electrically driven mechanisms.

Few survive today

Today, few gravity tower clocks remain working in their original locations. Most of the surviving clocks of



The new 30-foot tall Victorian clock tower measured 10-foot by 30-foot tall evoked the highly ornamental architecture of its earlier time.

this type were removed to be preserved in storage or display conditions where they sit idle without a tower or upper story cupola to allow the long drop required by the heavy weights necessary to drive them. Typically, the timekeeping machinery is anchored on a chassis lower in the building with a vertical drive shaft to operate the clock faces far above.

Foundation Director Jasper Sanfilippo and his curators commissioned

the Victorian Clock Tower to house a giant E. Howard Company #3 Tower Clock.

The new 10-foot x 10-foot, 30-foot tall tower would restore the capacity for historically correct, gravity-driven operation of the clock and evoke the highly ornamental architecture of its time. It would be permanently installed in the Foundation's Eden Palais Pavillion.

Working together met challenges

The design concept for a new steel and cast iron tower was a collaboration between architect/designer Lee Pharr, Foundation curators, and Sanfilippo himself. Lee Badger was commissioned to bring the design into reality at his Anvil Works studio in Hedgesville, WV.

Constructing the tower was more than a fabrication challenge. It was an exercise in creative collaboration, construction coordination, logistics, and metal working versatility.

Badger was regularly in touch with the design collaborators to assure that the tower met its functional and aesthetic requirements. Curators worked out mechanical details and came to the Anvil Works shop to oversee the critical placement of internal catwalks, mechanism mounting plates, and supports. Badger and the architect/designer conferred often to adjust and adapt structural and ornamental details.

Numerous fabrication processes

The greatest challenges during construction were managing a multitude of details and combining a diversity of metal fabrication processes.

The ornate Victorian design required hand-forged pieces to coordinate with ornamental castings and structural steel. Different castings were divided, recombined, and assembled to fit the tower's proportions and dimensions. Badger used a variety of cutting, bending, forming, welding, and joining techniques to achieve the necessary combinations. Steel tube, sheets, and plates formed the structure.

The tower combines more than 14 tons of structural steel, ornamental castings, stampings, and hand-forged elements. It was fabricated and assembled in eight sections:

- Three upper frames.
- Four column assemblies.
- The base.

Badger erected additional tem-



Lee Badger with face frame. Each of the tower's 10-foot x 10-foot frame sections was completed individually, wiped clean with denatured alcohol, pre-primed with high-build auto-body primer, and "finished" with a protective working coat of satin black enamel.

porary storage racks outside his 1,800-square-foot shop to receive all the standard stock steel at one time and save on shipping, delivery, and receiving costs.

The Joseph Kavanagh Company, Baltimore, MD, a fourth generation family-owned metal bending and rolling business, provided the arcs of 4-inch x 4-inch x 1/2-inch square tube that form the tower's arched gables. The largest structural arcs are 5 feet x 10 feet. Kavanagh also bent the smaller arcs and circles necessary to the clock tower's structural, functional, and ornamental design.

Decorative pressed steel sheet used in the tower's capitals, cornices, and moldings came from the W.F. Norman Company's 1909 "Hi-Art" catalog. The company's panels can be

fastened to wood backings and supports, and many cornices and moldings ship with profiled wood blocks used for reinforcing hollow shapes and all seams where pieces join and overlap.



Welding Flutes on Columns. 288 reeds cut from $\frac{3}{4}$ -inch, half-round steel were plug welded on the pipe columns.

The manufacturer's recommended installation technique required furring strips to be glued and screwed to the tower's steel structure to allow fastening into the wood support every six inches around the perimeter of each piece.

Design departures

Although the original design concept called for fluted columns, no cost effective way was found to cut flutes into 8-inch schedule 40 pipe, while maintaining structural integrity. Instead, 288 reeds cut from $\frac{3}{4}$ -inch, half-round steel were plug welded on the pipe columns to achieve the desired effect.

There was only one other significant departure from the original design concept. Historic hanging lanterns salvaged from a theater replaced the reproduction gas lamp lighting fixtures affixed to the tower's mezzanine.

Mountain State Machine Tool Inc., Kearneysville, WV, satisfied the specifications for some of the clock tower's functional fittings.

They collaborated closely with Badger in fabricating the weights that would power the clock and its chimes through a system of winding barrels and pulleys. Their mass would be adjusted by adding or removing lead shot. Badger fabricated cylindrical shot buckets from steel pipe, and Mountain State machined brass sheaths to take a high polish.

Fabrication efficiency

To control and simplify the number of simultaneous fabrication and finishing processes going on in his shop, Badger contracted Luther Zimmerman, an artist-blacksmith from nearby Hagerstown, MD, for construction of ornamental railings and gates attached around the tower's base.

Zimmerman is known in the area for his independent skill and ability to produce fine, custom-forged work for historic preservation and restoration purposes.

Badger engaged the rigging services of D & L Weld Inc., Martinsburg, WV, to move the large structural frames in and out of the Anvil Works' shop.

Fabrication of the upper frame joining the columns with the clock face required structural welding on all six sides. Badger began fabrication of this piece upside down, and D & L took the two-ton, 10-foot x 10-foot frame outdoors to flip it over and replace it in the shop for completion in its proper orientation.

Each of the tower's 10-foot x 10-foot frame sections was completed individually, wiped clean with denatured alcohol, pre-primed with high-build



Top Frame Structure. Fabrication of the upper frame joining the columns with the clock face required structural welding on all six sides.

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D & L stacked the completed sections outside, in front of the Anvil Works shop. The growing structure drew press attention and the wonderment of casual passers-by.

After 10 months of construction, the upper frames, base, and column assemblies were trucked to Illinois for assembly in the hangar-sized building where a concrete foundation was poured with a rectangular pit to accommodate the clock mechanism's six-foot-plus pendulum.

The night before final assembly in the Eden Palais Pavillion, the clock's four historic cast iron faces were glazed with white opaque glass and fastened into their new steel rims.

The next day, after positioning and anchoring the base and columns, overhead conditions in the interior space required a delicate dance with a Pettibone crane truck to set the upper sections in place. This was the first, only, and final time that all eight pieces of the tower were fitted and bolted to-

gether into a single structure.

Curators and mechanical restoration experts on the Foundation staff installed the historic clockworks, carefully arranging and placing the necessary pulleys and mechanical attachments.

The restored timekeeping mechanism, in its green and gold painted chassis, was anchored to a polished hardwood floor, newly installed in the tower's steel base.

Operational fittings and adjustments took another year. A specialist on the Foundation staff designed and applied the elaborate painted and gilded finish.

Equally ornate and unusual mechanical antiques surround the tower in its permanent setting, including the Eden Palais carousel, fairground and dance hall organs, several steam engines, and a locomotive. 🌟

Thanks to Steve Dykstra at Anvil Works for contributing this article and photos.

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