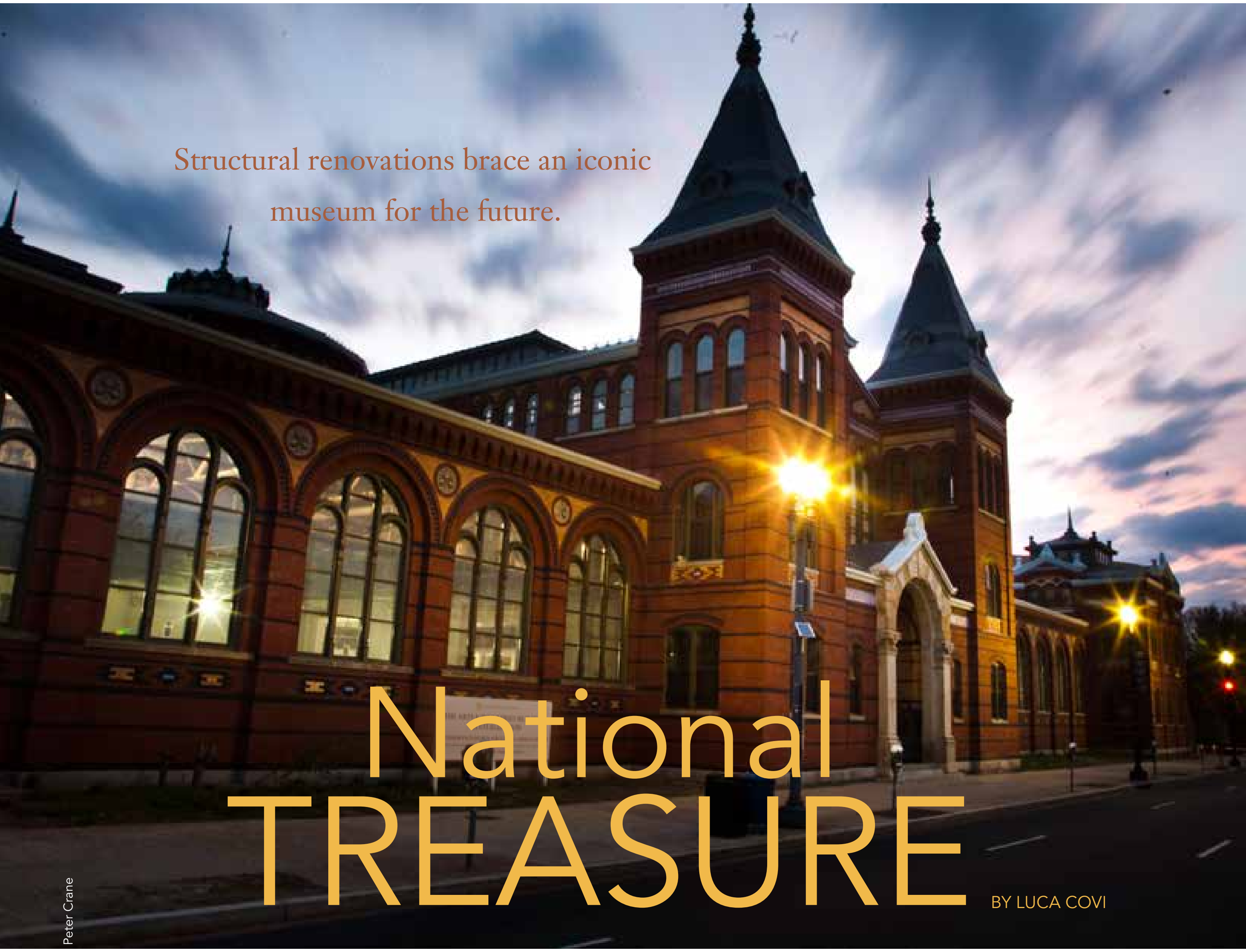

Peter Crane

Structural renovations brace an iconic museum for the future.

National TREASURE

BY LUCA COVI

The building first opened in 1881.

THE SMITHSONIAN INSTITUTION'S Arts and Industries Building is widely known as the first U.S. National Museum.

The dream of the Smithsonian's first curator, Spencer Fullerton Baird, it was designed by architecture firm Adolf Cluss and Paul Schulze and first opened its doors in 1881. In recent years, renovations became necessary thanks to roofing, HVAC and plumbing leaks, which led to structural renovation as well. Exterior enclosure and structural improvements to the 102,200-sq.-ft structure were completed early this year at a total construction cost of roughly $44 million.

As with any National Historic Landmark, there is a delicate balance in preserving a structure's historical elements while also revitalizing the building to meet the needs of the present day. Using prior knowledge of the original construction time frame, the architects were able to successfully depict an overwhelming majority of elements, despite the fact that many were hidden in three to five wythes of masonry.

The design team performed an extensive amount of existing condition surveys, which was an integral first step in completing the roof replacement and in kind, the repair/replacement of the structural framing. The existing lead-coated copper and slate roofing was replaced with 20-gauge stainless steel and new slate to match the existing patterns, and the new roofing system weighed considerably more than the existing one. The new structure needed to not only support the additional weight of the new roofing system, but also improve seismic, wind, blast and snow load performance.

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Photos this spread: Christopher Feehely

Exterior enclosure and structural improvements to the 102,200-sq.-ft Smithsonian Institution's Arts and Industries Building were completed early this year.

The four quads were integral to one another and required significant in-house engineering to ensure proper fit-out of new and existing structural members between quads. Each quad consisted of approximately 2,200 pieces of steel weighing approximately 125 tons per quad.

The building is laid out as four quads around a central rotunda. Each quad consists of six individual structures (hall, court, transition, range, entrance/tower and pavilion) that were systematically demolished and rebuilt using modern steel components while matching the fabric of the original design. Each quad was unique in terms of dimension and geometrical configuration, a condition that required each area to be field checked for correct dimensions and elevations; in some cases, 3D sketches were drawn by hand in the field. Our team took this information and loaded it into SDS/2 to develop fabrication and erection drawings, and the field checking and modeling exercise totaled in excess of 3,000 labor hours.

The four quads were integral to one another and required significant in-house engineering to ensure proper fit-out of new and existing structural members between quads. Each quad consisted of approximately 2,200 pieces of steel weighing approximately 125 tons per quad, 15,000 pieces of hardware (A325 and A490 TC structural bolts with nuts and washers of various diameters and lengths, as well as 2,400 Hilti epoxy anchors of various sizes) and 26,000 sq. ft of decking. A portion of the existing iron structure was reused, requiring significant remediation to meet the new structural requirements.

Installation of the new structural framing began on the rotunda roof, then the team moved into the southwest quad hall structure and continued in a clockwise fashion around the building, finishing with the topping out of the roof structure replacement. The

Installation of the new structural framing began on the rotunda roof, then moved into the southwest quad hall and continued in a clockwise fashion around the building.

final enhancements were made to existing trusses in the southeast range portion. Each truss was at a different elevation and the required improvements had to be made on a per-truss basis to allow the roof system to be installed properly.

One key strategy to the success of this project, and a great example of innovation, was the use of temporary scaffold decks. The scaffold decks provided the necessary work platform, acted as temporary roofing and provided lateral bracing of the exterior walls. In lieu of trying to find a way to keep water from entering the building, our team developed a plan to purposefully route the water inside. To accomplish this, we built scaffolding platforms just below the existing roof levels with knee walls and waterproofed them to the existing walls. To maintain consistent temperature and humidity levels between the inside and outside of the walls,

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we installed vents in the knee walls. On the scaffold decks, we installed an ethylene propylene diene monomer (EPDM) layer and floor drains. To protect the EPDM roofing (since the scaffold decks were the main work platform) we covered the entire surface with horse mats. Although rubber horse mats are normally used for lining stables, we found them to be perfect for our application as well, and we have been able to reuse almost every single mat on other projects. This system allowed the ironworkers to perform elevated work at what felt like ground level.

To enhance productivity, Grunley established a work sequence that flowed from the highest roof elevation to the lowest elevation, while simultaneously progressing clockwise around the building. The installation of each level of roofing was followed by window installation. This productive sequence reduced the risk of damage to the new windows, limiting the need to work off of the newly installed roof and ensuring safety for workers by reducing overhead activities. A tower crane was erected in the southeast quadrant and was able to reach 90% of the roof structure. Since staging was limited and all material deliveries had to be strategically scheduled, the tower crane provided efficient material handling capabilities with the ability to reach all three staging and unloading areas. ■

General Contractor
Grunley Construction Company, Inc., Rockville, Md.

Architects
Ennead Architects, LLP, New York, and SmithGroupJJR, Washington, D.C.

Structural Engineer
McMullan and Associates, Reston, Va.

Steel Fabricator, Erector and Detailer
Superior Iron Works, Inc., Sterling, Va. (AISC Member/AISC Certified Fabricator/Advanced Certified Steel Erector)


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