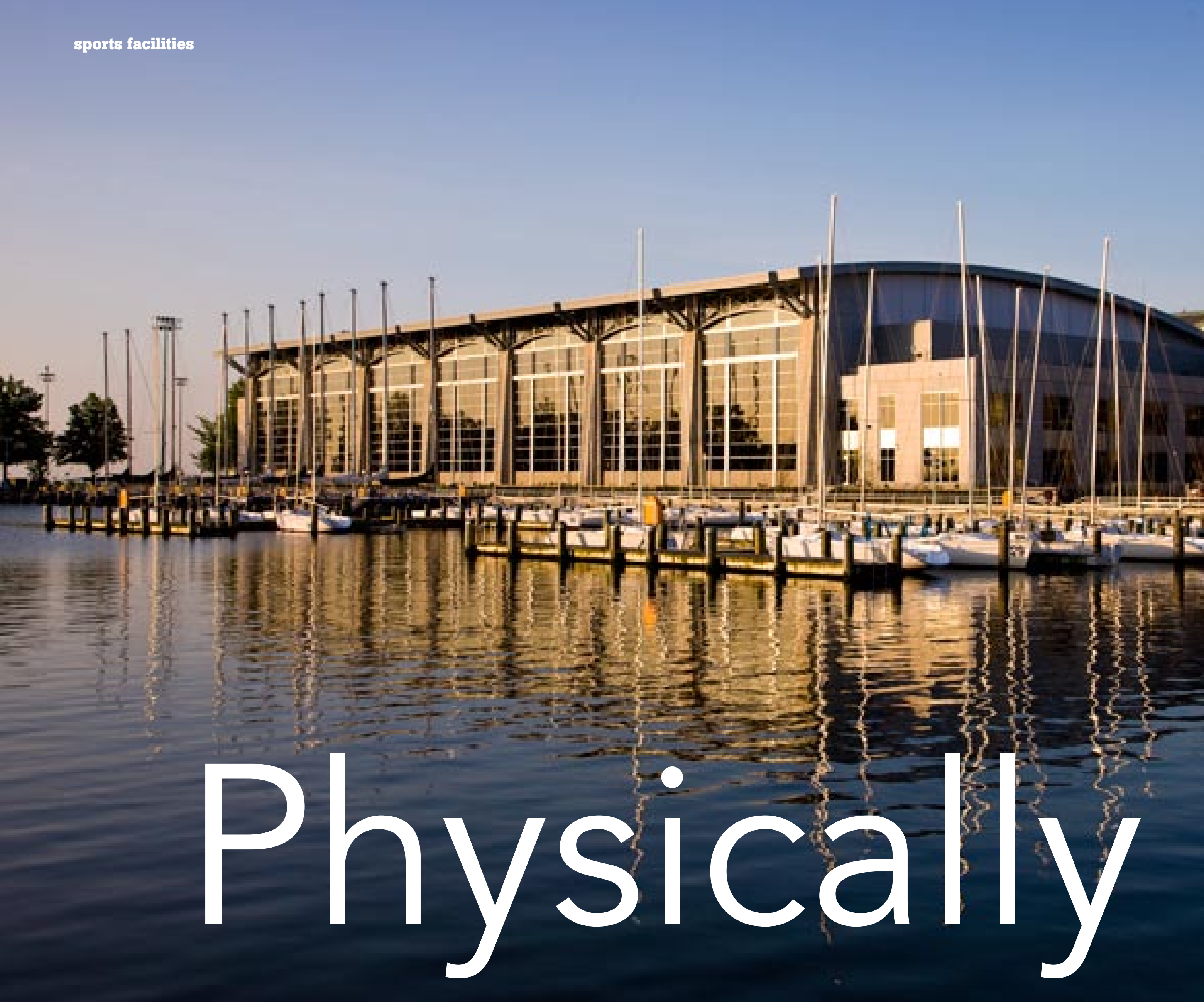

Physically

The sleek, new Wesley A. Brown Field House does its part to keep the U.S. Naval Academy strong.

THE PHRASE “PHYSICAL FITNESS” is likely to conjure up memories of high-school P.E. However, it’s a concept that is often cast aside in the transition from high school to college.

Of course, this isn’t the case at the United States Naval Academy in Annapolis, Md., where high standards for physical and mental fitness are givens. This commitment to strength of body is evident with the completion of the Wesley A. Brown Field House, which opened at the Academy last spring and will be used for varsity and intramural athletics.

The design-build contract for the project was administered and managed by the Naval Facilities Engineering Command (NAVFAC) in Washington, D.C., which conducted a design-build competition between four short-listed teams. The turnkey project was awarded to Hensel Phelps Construction Co., whose bid proposed delivering the project one month ahead of the originally proposed schedule and presented a world-class design that incorporates a 400-ft-long glass façade, providing views of the Severn River.

The steel mill order package was developed prior to completion of the design in order to ensure a May 2006 construction start. Construction took 22 months and was completed last March, and the building was dedicated in May, with the attendance of the building’s namesake, Lieutenant Commander Wesley A. Brown (ret.), the first African American midshipman graduate of the U.S. Naval Academy.

In the House

The Wesley A. Brown Field House includes several unique structural features. The barrel-shaped roof of the building was created with cambered box trusses that span 200 ft over the playing field/floor below. As an architectural feature, truss depths taper from 12 ft to 9 ft

Fit

BY MARK TAMARO P.E., MATTHEW HORNE P.E., AND CALVIN AUSTIN

Photos: Blake Marvin Photography, HKS, Inc.

opposite page: The Wesley A. Brown Field House's 400-ft-long glass façade offers views of the Severn River.

this page: The building's barrel-shaped roof was created with cambered box trusses that span 200 ft over the floor below.

over the length of the span. Steel columns support the trusses at the south end, while 60-ft-tall cast-in-place concrete pylons support them at the north end. The roof between trusses is supported by open web joists, and their design was controlled by wind uplift and antiterrorism force protection (ATFP) requirements.

Coordinating with the general contractor and the steel subcontractor, the design engineers established a truss system that could be prefabricated and shipped in three pieces. As with any long-span roof system, stability during construction was a major concern. The use of box trusses instead of planar trusses allowed the contractor to use only one shoring tower during erection without any additional stability bracing. Furthermore, the inherent stability of the box trusses in the erected condition enabled infill roof construction to begin after only two trusses had been installed. As a result, complete roof construction progressed uniformly instead of in stages. One truss was erected per week, and shortly after the last truss had been set, the roof was closed in.

The arched profile of the trusses produced lateral translation at the steel column-supported end. The dead load portion of this displacement was accommodated through the use of long slotted horizontal holes at the supports. Once the full dead load was applied, these connection bolts were then tensioned, and the subsequent live load horizontal displacement imposed an acceptable level of inter-story drift on the supporting columns above the roof. The metal panel cladding along this side of the building was detailed to accommodate the associated column rotation.

Blake Marvin Photography, HKS, Inc.

The building's lateral system is a combination of braced frames and moment frames that function as a steel lateral system not specifically detailed for seismic resistance.

Low Seismicity

The building's lateral system is a combination of braced frames and moment frames that function as a steel lateral system not specifically detailed for seismic resistance (commonly called the $R = 3$ lateral system). The low seismicity associated with the site made this system an efficient choice from both constructability and cost standpoints. The $R = 3$ system does not require seismic detailing of connections, which saved material, fabrication time, and erection time.

The use of both braced frames and moment frames eliminated the common difficulty of coordinating lateral element locations with program requirements. To further expedite detailing, structural engineer Thornton Tomasetti designed all of the bracing connections in-house. The braced frames use hollow structural sections (HSS) for the diagonals. The brace connections consist of single-gusset plates that were shop welded to the beams and field bolted to the columns. Oversized holes and fillet welded connections to HSS diagonals with slotted ends allowed for accommodation of field tolerances without schedule delays

Having a Blast

The broad glass façade along the Severn River posed a challenge for the design-build team because the façade was required to meet ATFP requirements. Second-order time-dependent analyses were performed by the team's blast engineer to verify that the HSS steel frame supporting the high-performance glass façade had sufficient ductility and ultimate strength to meet the blast requirements. Several design iterations were performed until a suitable combination of structural performance and aesthetic quality was achieved.

In addition to the "hardened" structural steel frame on the east façade, (facing the river), the south façade is supported by a horizontal truss spanning the concrete pylon and the line of steel bracing along the conventionally framed two-story bay of the building. This horizontal truss, 200 ft long by 15 ft wide, resists lateral loads on the façade and braces the top of the precast cladding, while it is vertically suspended from the southernmost box truss and bears on W24 column sections at 20 ft on center. The W24 columns also function as flexural elements to support the lateral and blast loads on the glass and precast south façade.

Magic Carpet Ride

The speed of the steel erection and rapid building close-in provided critical time for the field construction. The field house floor is supported by a concrete-framed two-way slab on piles with recesses for the multiple sports surfaces. The slab also has a 4-ft-deep trench following the profile of the running track and is designed to support the loads from a hydraulic track system, which can be raised and lowered to create an angled "super-elevation" along the curved portions of the track. The structure also accommodates the 76,000-sq.-ft "Magic Carpet" retractable synthetic turf system. This system is stored in 200-ft sections on a spool and is regularly set up and then retracted with a combination of nine electric winches and an 18-port in-floor air blower system.

The framing system ultimately gave the design-build team the tools and versatility necessary to fast-track the design and construction of this long-span, multipurpose facility. Incorporating the scenic waterfront views with an elegant steel framed façade also helps ensure that this $51-million project maintains the world-class standards of the U.S. Naval Academy. MSC

Photos: Blake Marvin Photography, HKS, Inc.

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