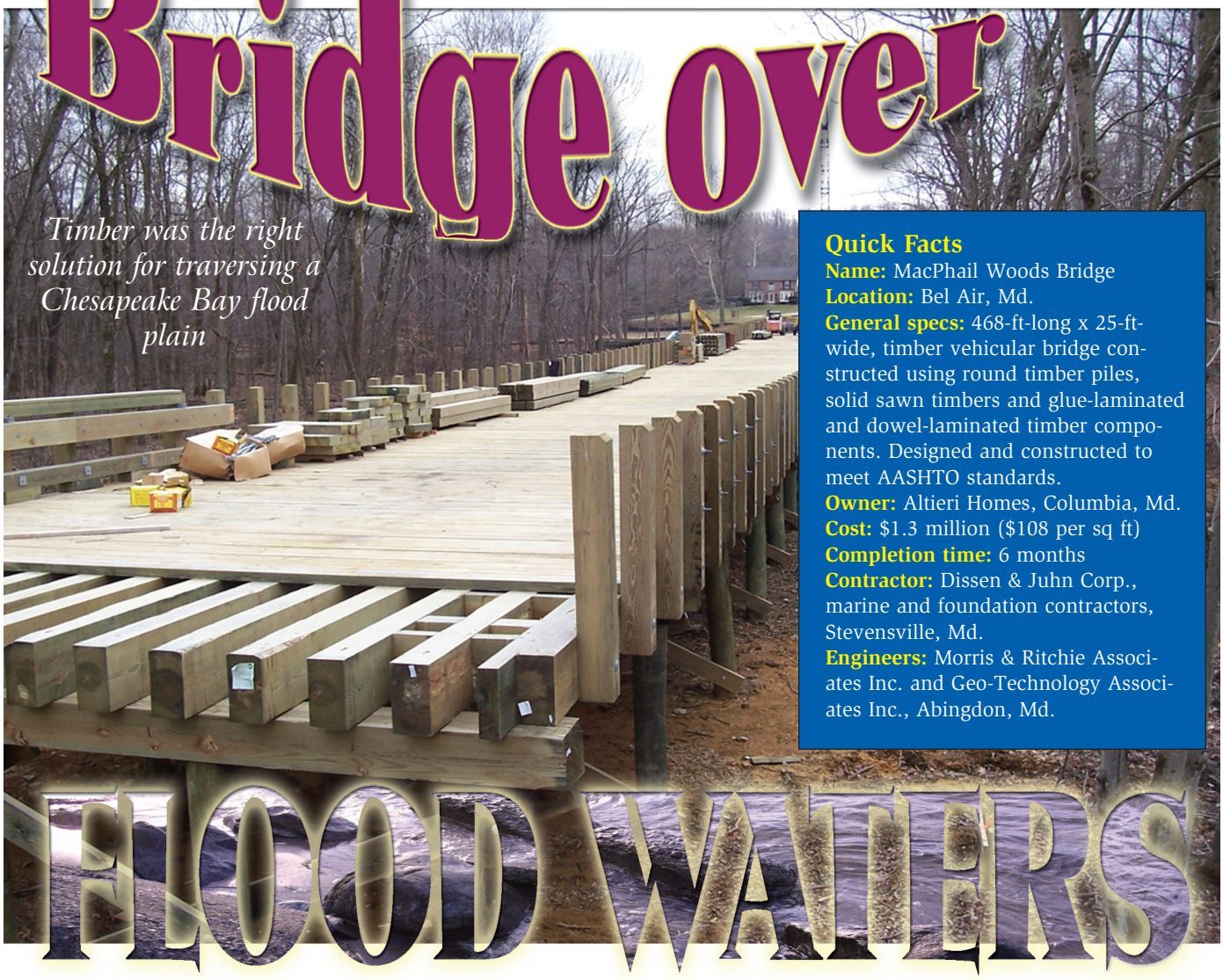
BY GILBERT W. DISSEN
CONTRIBUTING AUTHOR

Bridge over FLOOD WATERS

Timber was the right solution for traversing a Chesapeake Bay flood plain



Quick Facts
Name: MacPhail Woods Bridge
Location: Bel Air, Md.
General specs: 468-ft-long x 25-ft-wide, timber vehicular bridge constructed using round timber piles, solid sawn timbers and glue-laminated and dowel-laminated timber components. Designed and constructed to meet AASHTO standards.
Owner: Altieri Homes, Columbia, Md.
Cost: $1.3 million ($108 per sq ft)
Completion time: 6 months
Contractor: Dissen & Juhn Corp., marine and foundation contractors, Stevensville, Md.
Engineers: Morris & Ritchie Associates Inc. and Geo-Technology Associates Inc., Abingdon, Md.

Siting a residential housing development on a hill above a flood plain can provide beautiful scenery for the residents, but it also can make transportation to and from the development tricky. Robert Hockaday, a Baltimore developer, knew he would have to build a bridge over the Maryland flood plain to provide access to the development. Where other builders had looked at the site and turned it down, Hockaday planned the 468-ft MacPhail Woods Bridge.

Bel Air, Md., is located in northern Maryland about 25 miles northeast of Baltimore. The small town of 10,000 serves as the county seat for Harford County, one of 23 counties in the state. Aside from having John Wilkes Booth as its most infamous citizen, Bel Air is generally known for being a quaint small town with an inviting, picturesque landscape.

However, like many small towns throughout Maryland, this former horse country is slowly being developed into a residential suburb with a number of condominiums and housing developments in the works. The sheer beauty of the area makes it a developer's paradise. After all, with a nonexistent crime rate and its "Mayberry-esque" charm, who wouldn't want to live or retire here? That is just what Hockaday thought. Like most good ideas, however, the thought was a lot easier than the follow-through.

With recent escalations in the cost of steel and concrete, timber bridges are benefiting from increased scrutiny as a design alternative.

A single span, 52 ft in length, was required to bridge Bynum Run itself. Eight 14-in. x 30¼-in. glue-laminated timber beams were strung between pile bents on either side of the stream.

With recent escalations in the cost of steel and concrete, timber bridges are benefiting from increased scrutiny as a design alternative. In addition to the abundant supply of raw material, timber bridges are often quicker to build. Since timber components are smaller in size and lighter in weight than their steel and concrete counterparts, smaller equipment is required to install and service them. Alternative designs for timber bridges, though numerous, benefit from many standardized design and construction techniques, also helping to keep installation costs low.

For a long time, the knock against timber was that it had a short service life. However, by its very nature, timber is an extremely durable material. It has a remarkable ability to handle short-term overloads without adverse effects and has the added advantage of holding up to freezing and thawing cycles while resisting deterioration from deicing agents. Now, with the

"There were several builders who looked at this property before me and opted out," said Hockaday. "I don't give up easily. I have developed numerous sites and I look for tough ones where a niche product can emerge."

Hockaday planned on building a luxury, active-adult residential community on a 40-acre wooded parcel. Plans were drawn up to build 114 condominiums on the site, which was perched on the side of a hill and offered breathtaking views of the surrounding woodlands. However, accessing the site was a problem. Lying at the base of the hill, between East MacPhail Road and the proposed condominiums, was Bynum Run, a small stream with a large flood plain that is part of a 15,000-acre watershed that empties into Chesapeake Bay.

It was clear that Hockaday had to traverse the flood plain not only for residential access, but also for construction access. The new bridge would be the only way into the site. Like most construction projects, this one had a tight budget. In addition, Hockaday had to wrestle with permitting, project delivery and aesthetic issues as well.

Why timber?

Coming to terms with the most appropriate building material to use to construct this huge structure was the first logical step. In northern Maryland, timber bridges are not very common like they are on the Eastern Shore and Virginia's Tidewater Country, where the sandy soils are more conducive to driving timber piles and where there is a ready supply of low-cost southern yellow pine. Although conventional steel and concrete bridge designs were considered, they were discounted due to cost and time constraints, aesthetic preferences and perceived permit concerns.

So why consider timber? Many people choose timber for various reasons, chief among them cost, strength, durability, environmental friendliness and aesthetics.

advent of new wood preservation techniques, timber bridges last much longer. It is estimated that with proper maintenance, the MacPhail Woods Bridge could have a lifespan of more than 100 years.

Another benefit of timber construction is that it is generally less disruptive to the environment. Unlike alternative designs that utilize long spans and large piers, timber bridges utilize short spans and pile bents that do not require large excavations, cofferdams, dewatering or other procedures disruptive to sensitive environments. In many instances, a timber bridge can be built entirely from the deck down, with minimal disturbance to ground-dwelling plants and animals.

Since the MacPhail Woods Bridge is located over a 100-year flood plain and nontidal wetland, it was particularly essential that the bridge not be obtrusive to the environment and the wooded surroundings.

"With a concrete and steel bridge, the rule of thumb is the longer the span the more robust the foundation needed, which would have caused substantial disturbance at this site," said Ray McMaster, P.E., contract manager for Dissen & Juhn Corp., Stevensville, Md., the marine and foundation contractor that ultimately built the MacPhail Woods Bridge. "This timber bridge fits neatly into the landscape."

In some cases, aesthetic concerns can make timber bridges a preferred alternative over other types. A case in point is three bridges at the Hyatt Regency Chesapeake Bay Golf Resort, Spa & Marina in Cambridge, Md., which inspired the MacPhail Woods Bridge. The Hyatt bridges create what the resort's architect described as "that Chesapeake feel." They help maintain the aesthetic continuity between timber pedestrian bridges, boardwalks, bulkheads and docks that are integral to the facility.

Although the other benefits of timber bridges were important, it was the aesthetic appeal of a timber bridge that really sold Hockaday. He wanted not only a functionally practical and affordable bridge, but also one that was unique and truly beautiful in design that fit perfectly with its location.

"My wife and I are building a house on the Eastern Shore, so we visit the Hyatt frequently. When you cross that bridge to go onto the property there is a certain feel to the experience, an aesthetic appeal. It is very natural and the bridge blends in with the environment. I wanted those qualities for my bridge," Hockaday said. "I asked around and found out that Dissen & Juhn did the construction at the Hyatt."

Beauty, location and durability

Once Hockaday's project team was assembled, work began on the design and permitting of the structure. Structural engineers from Morris & Ritchie Associates Inc. of Abingdon, Md., working closely with engineers from Dissen & Juhn, optimized the design for permitting, constructability and cost.

"This project gave us an opportunity to use our design-build expertise to construct a uniquely designed, attractive timber bridge while easily saving the client a year in permitting and planning," said McMaster. "We worked with the client's designer directly and was able to fine-tune the preliminary design, which not only saved time but also money. What easily could have been a 1½- to 2-year project was completed in six months."

A unique aspect of the bridge at MacPhail Woods is that it utilizes three types of spans:

- 393 linear ft of conventional, stick-built construction with pile bents on 16-ft centers. Each bent contains five Class B timber piles driven to bedrock and cross-braced and a 12-in. x 14-in. solid, sawn timber pile cap. The bridge superstructure consists of 8-in. x 16-in. solid stringers on 18-in. centers and 3-in. x 10-in. deck boards;
- A single span, 52 ft in length, was required to bridge Bynum Run itself. Eight 14-in. x 30¼-in. glue-laminated timber beams were strung between pile bents on either side of the stream, then 6-in.-thick, dowel-laminated transverse deck panels were installed on top of them;
- Lastly, a 23-ft-long span was required to bridge a utility easement. In lieu of stringers on this span, 14-in.-thick, dowel-laminated deck panels were attached directly to pile bents on either side.

In addition, the bridge features cast-in-place concrete abutments on spread footers, a heavy-duty curb-and-guardrail system and asphalt paving. Mechanical fasteners include ¾-in. galvanized timber bolts and drift pins.

With the exception of the dowel-laminated deck panels, which are made of douglas fir, all timber components are made of native southern yellow pine and are treated with either chromated copper arsenate or copper naphthenate preservative.

Five men plus heavy equipment

Once the design was completed, the actual construction took place rather quickly. In fact, the project was started in September 2005 and completed in March 2006. Remarkably, a five-man crew aided by a 40-ton Link-Belt 108B crane and a 70,000-lb Komatsu PC300LC-6 hydraulic excavator completed the job in six months.

Once the site was cleared for construction, crews began the pile-driving operation. The 25-ft-long timber piles were driven to a minimum penetration of 8 ft using a conventional diesel hammer. In those relatively few instances were the minimum penetration could not be achieved because of a shallow subsurface rock formation, concrete collars were installed at the base of the pile bent to provide additional lateral support. Once all of the piles were driven, they were cross-braced for added stability and capped to complete the bridge substructure.

To lessen any environmental disturbance, the contractor elected not to install a temporary service road through the flood plain. Instead, equipment and materials were brought to the site by "matting out" to it. Using this approach, the tracked equipment crawled out on timber mats placed on the ground. When a section of the bridge was completed and the crew needed

more "road," the crane picked up the first timber mat and placed it at the back of the line, extending their path as the equipment passed. This approach proved advantageous, since the jobsite flooded several times during construction, and the flooding would have washed out a service road.

Like the pile caps, the solid, sawn timber stringers were set from ground level with the excavator operating on timber mats. Both caps and stringers were precisely located, then pinned in place with ¾-in. x 30-in. galvanized drift pins. The 52-ft-long glue-laminated beams spanning Bynum Run were set from atop one of the bridge abutments with a 40-ton crane, as were the dowel-laminated transverse deck panels.

The shorter, 23-ft span was set from ground level as well. A guardrail system of 8-in. x 8-in. posts, 8-in. x 8-in. curbs and 8-in. x 12-in. rails was erected next. Last, the 3-in. x 10-in. bridge deck was installed and the whole structure paved.

Special finishing touches

In addition to detailed carpentry work, the MacPhail Woods Bridge includes some unique features, such as a waterproof deck. A waterproof membrane was sandwiched between the asphalt base and finish courses. Guidelines published by the U.S. Forest Service were used to design and install the paving system.

"There was oversight by Harford County," said Matt Pearce, project engineer for designer Morris & Ritchie. "Even though this is a privately owned bridge, the county applied the same level of design review as if it were publicly owned. They were concerned that they would end up taking ownership if the bridge was not well-maintained. One of the project goals was to minimize the required maintenance on the bridge, and I think that we accomplished this through good detailing and construction."

Thanks to the diligence of developer Robert Hockaday and Morris & Ritchie and the design and construction expertise of Dissen & Juhn, the bridge is now handling steady traffic of construction vehicles working on the completion of the MacPhail Woods condos.

"The quality and workmanship of this bridge has added great value to our property at MacPhail Woods," said Hockaday. "We were able to design and build something unique with aesthetic appeal and save time and money while also using the property more efficiently so Altieri Homes has been able to generate more units from the land." R&B

Dissen is president of Dissen & Juhn Corp., a marine and foundation contractor in Stevensville, Md.