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Digital Planning Pays Off in the Field

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and overall operations.

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'Early decision-making is how we maximize prefab: It brings the right people together at the right time to determine what is best for the project.' Photo: Harris.

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BY STEVE SMITH

We guess you could call the structure located at the corner of North 7th St. and North 19th Ave, just west of downtown Minneapolis a "garage."

The two-story 668,000-square-foot facility under construction for Metro Transit, the primary public transportation operator in the Minneapolis-Saint Paul area, will indeed include storage space for 216 buses, 24 maintenance bays, fueling and washing space and administrative offices. Expected to be completed later this year, the \$113 million garage is also being built with the environment in mind and will feature a solar thermal wall, a rooftop solar array and a stormwater reclamation system (more on that later).

Since the project broke ground a little over two years ago, the Heywood Bus Garage Constructors, a joint venture of Knutson Construction and Adolfsen & Peterson Construction, has relied on Harris, based in St. Paul, and one of the country's largest mechanical

contractors, for the PHCP work.

"All of our projects start with a 'prefabricate everything' approach," says Michel Michno, CEO, Harris. "Our processes not only focus on prefabrication, but also on early decision-making and planning. Early decision-making is how we maximize prefab: It brings the right people together at the right time to determine what is best for the project."

Harris ranked 8th among the top 50 mechanical firms in the 2021 Top 600 Specialty Contractors list published by Engineering News-Record. The company ranked 53rd overall. Since opening its doors nearly 75 years ago, Harris has grown to 15 regional offices with more than 2,000 employees.

Garage work

Throughout the long Heywood project, Ryan Cousineau, project manager, Harris, has kept tabs on the mechanical contractor's push toward value engineering and prefab, all of which starts long before the work in the field begins.

"Prefabrication has been evolving for decades," Cousineau adds, "but especially in the last 5-10 years as owners want more complex buildings, and they want them done faster while still maintaining a manageable budget."

General contractors also push owners to bring in key MEP trades sooner when a construction project might still be in the concept and design stage.

"Our goal at the beginning of a project is to work closely with the owner, architect, engineers and general contractor to design a building that meets everyone's needs – and we try to do this in a way that saves as much construction time and money as possible," Cousineau explains. "It's a missed opportunity otherwise and one more reason to have communication with the entire project team very early on."

As Cousineau notes, CAD, VDC, BIM and prefab have all transformed how contractors think about design stages, as well as the process in which buildings are constructed. He says Harris' vision on the Heywood

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project grew as they sat down and began to find ways to make the project even better. Accustomed to design-build, what started as a plan-spec job constructing mechanical straight off the prints turned into much more.

“We saw where prefab could save time and money on the project and presented our ideas and their benefits to the GC and owner during the preconstruction phase,” Cousineau says. “Sometimes it’s about educating the owner and exploring what’s possible when you bring on an experienced mechanical contractor as a partner. We have a big blend of opinions and expertise at Harris that helps to provide innovative solutions.”

Opportunities payoff

Cousineau adds that while not all Harris’ recommendations on the Heywood project were accepted, the consortium did say yes to two-thirds of its PHCP redesign ideas, which added up to reducing more than a mile of piping from the original

design, and provided \$1 million in value-engineered savings thanks to opportunities to prefabricate work and engage in project planning early on.

Here are some more details on the project worth considering:

- The stormwater reclamation system and overflow storm system were redesigned to reduce total footage by more than 3,600 linear feet, a 33 percent reduction.

- The building’s heating/cooling plant was changed from a water-to-water heat pump plant to a simultaneous heating and cooling plant with waterside economizer.

These value-added options increased the cooling capacity by 50 tons. The main chilled water system went to 216 gallons per minute from 300 gallons per minute, reducing the chilled water mains to 4-inch pipe from 6-inch pipe, which in turn reduced the total volume of the chilled water system by 41 percent.

- For the hot water system, mains were dropped to 8-inch pipe from 10-inch pipe, and the heated water

piping system was reduced by 1,700 linear feet. This reduced system volume by 20 percent.

As a result, pumps, air-handling units, expansion tanks and air separators, roof hoods, and simultaneous heat/cool heat pumps were re-selected. The changes are projected to save more than \$30,000 per year in energy costs by using simultaneous heating/cooling, pumping reductions, fan horsepower reductions, and optimizing the use of the geothermal field. Finally, the reduction in the previous numbers of compressors, motors, dampers and controls, is expected to also reduce maintenance costs.

- Redesigned ductwork dropped the material weight to 317,000 pounds from 459,000 pounds, a 31 percent reduction.
- The sequence of operations was rewritten to reduce 194 points.
- Simultaneous heating/cooling heat pumps were made into a single packaged unit for easier control.
- Ductwork was calculated fitting to fitting to remove all 4-inch

Hub-and-Spoke Approach

Harris has been a long-time proponent in leveraging advanced modeling tools and employing BIM early on, making it easier to identify ways to maximize prefabrication and modularization. Physical and functional building characteristics can be seen virtually at the Harris offices well before shovels even hit the dirt in reality.

The Heywood Bus Garage project is only the latest example of Harris’ handiwork. Another major recent project for Harris was taking charge of the PHCP systems for Allegiant Stadium in Las Vegas, which opened in 2020 as the new home of the Raiders.

The stadium work included more than 70,000 hours of fabricated plumbing, piping and ductwork assemblies, with Harris crews constructing 72-foot rack sections (two 36-foot sections each) to distribute HVAC and plumbing utilities to the various floors and concourse areas.

Because there was no overhead steel or floor to support the risers, engineers needed to come up with an alternative way to support the rack modules. What they did was construct a partial gravity and partial friction support system. BIM played a crucial role, helping to analyze constructability, configure the modules and detail structural attachments.

Of the eight riser racks built, six were constructed in a Harris prefabrication facility then delivered to the site where they were lifted off trucks and set in place. While the risers built conventionally took about 2,000 hours, the prefabricated risers took about 520 hours each – with only 70 hours of installation time on site. The racks also eliminated the need to work in an enclosed shaft with limited access.

The stadium project also included prefabricating large bathroom water in-wall modules, water heater skids, pump skids, sump racks, piping distribution racks and plumbing fixture assemblies. The units were prefabricated

and stored off-site, delivered just-in-time, distributed to the appropriate level and set in place in an efficient manner.

How do the components get to the job site? Harris uses a hub-and-spoke strategy, with the hub being the project site and the spokes branching out to designated prefabrication shops, as well as to co-fabrication sites on or near the project.

The process creates just-in-time delivery and installation. Bulk materials are fabricated in a main facility, then flat-packed and shipped to a co-fabrication site. Final assembly is completed and prefabricated components and modules are delivered to the building, often being lifted into the air and immediately installed.

Harris’ fabrication teams work with the most advanced cutters, drills, welding equipment and plasma tables, providing customers with unmatched precision at high speed. Its crews are certified in pressure vessel repairs and alterations, power piping, power boilers and a wide range of welding specialties.

In preparation for the increased application of prefab, two years ago, Harris added a plumbing-focused fabrication shop in St. Paul, Minnesota. The space was definitely needed as crews prefabricated all of the underground plumbing for the Heywood Bus Garage project.

At the same time, Harris also opened its in-house Design Studio, which delivers a collaborative approach to design and engineering. Based in Oakland, California but with Harris team members across the country, the Design Studio bridges the gap often seen between construction and design by prioritizing planning, understanding client needs and goals and addressing concerns – early on and throughout a project’s journey.

Its team of skilled designers, engineers, preconstruction experts and building-simulation specialists provide building owners with a holistic approach to create efficient, cost-effective and sustainable building systems.

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A stormwater reclamation system at the Heywood Bus Garage project includes a 40,000-gallon fiberglass tank, which is expected to save up to 13,000 gallons of water a day. Photo: Harris.

pressure class duct material costs, field install coats and costs related to ductwork sealant class.

- Harris provided Revit drawings to the engineer of record to use in the revised project change order drawings to reduce rework. And, Harris used a live Bluebeam studio session for using redlined PDFs of the construction documents as the basis of its VDC.

The JV's clash detection team was able to work hand-in-hand with Harris to pre-model the majority of the mechanical/plumbing systems for the building, which allowed Harris to prefabricate most components. As a result, most components were put together offsite, ready to be installed when they arrived at the job site, streamlining the construction process.

By the time the prefabricated materials arrived at the site, 75 percent of the labor associated with that work had already been completed off-site. Then it's just final assembly and installation, which improves jobsite safety, product quality and helps meet fast-paced

schedules.

One of the last components Harris completed for the project included the prefabrication of a massive pump skid. The 21-foot by 10-foot skid, weighing roughly 15,000 pounds houses the base-mounted pumps, expansion tanks, air separators and pot feeders for the chilled water, ground source water and heating water systems running the building.

By prefabricating the skid, Harris was able to allocate several hundred hours to a controlled environment fabrication shop and also shorten the pump installation and piping activity schedule to one day in the field. Harris engineers within its BIM/VDC division produced the CAD drawings which allowed the prefabrication team to build the unit with exact precision.

"The working relationship that both parties of the JV have with Harris made it very easy to produce value engineering options to present to the owner to help drive the total costs down for the project," says Jacob Garr, assistant project manager at Knutson. "Many of the



Harris' work on the 668,000-square-foot Heywood Bus Garage project included prefabricating a massive pump skid. The 21-foot by 10-foot skid weighing roughly 15,000 pounds houses the base-mounted pumps, expansion tanks, air separators and pot feeders for the chilled water, ground source water and heating water systems running the building. Photo: Harris.

ideas actually provided a better product for the owner as well. The collected knowledge and experience that Harris and the JV have together makes it very easy to work through any issues that arise, which is key, especially for mechanical scope, which is typically one of the most complex."

Stormwater Reclamation System

One of Harris' adopted re-designs during the early VE process was to add vortex filters to the storm piping/pre-filtration part of the stormwater reclamation system. Harris made the recommendation as vortex filters provide better filtration and lessen maintenance costs and would also save the owner valuable floor space throughout the garage. Harris also set the 40,000-gallon fiberglass tank in place. The tank measures 72 feet long with a diameter of 10 feet and weighs 11,600 pounds. The tank rests 23 feet below-grade and is expected to save up to 13,000 gallons of water a day.

Multiple filtration systems capture and treat runoff from the building's roof, which will ultimately be used to wash buses. The Mississippi Watershed Management Organization, a quasi-government agency designed to protect the urban watershed that drains into the Mississippi River, collaborated with Metro Transit for three years to design a system that could offset its water use.

Besides the huge buried tank and vortex filters, other components for the reclamation system include, ozone filters (oxidizing disinfectant for maintaining water quality held in storage) and piping from the ozone filter to the bus wash.

To maximize long-term tank performance, all excavated soil for the underground reuse system was replaced with approved backfill material consisting of clean pea gravel aggregate. To meet the city's stormwater management requirements, a dry pond and sump catch basins were also included in the design.