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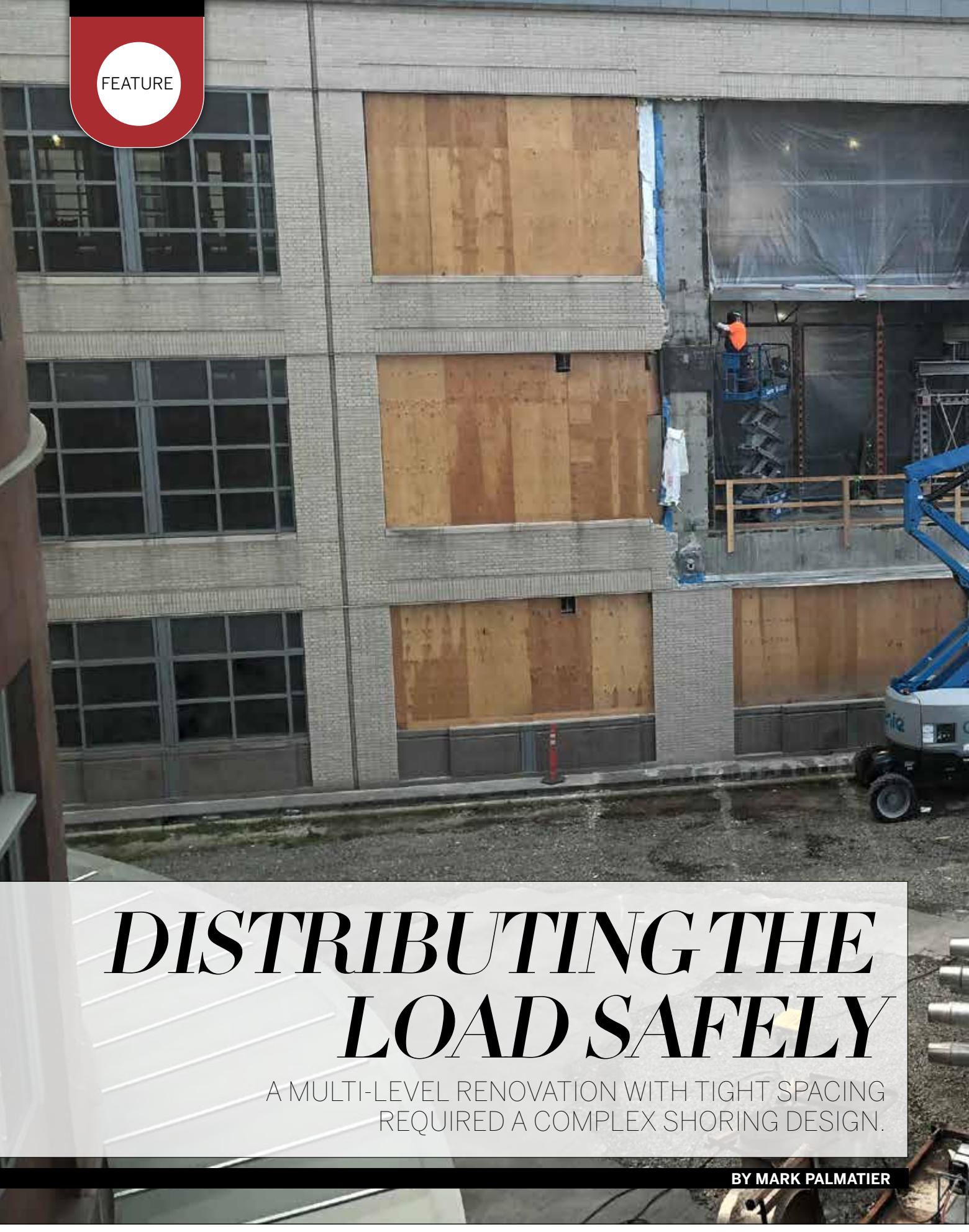
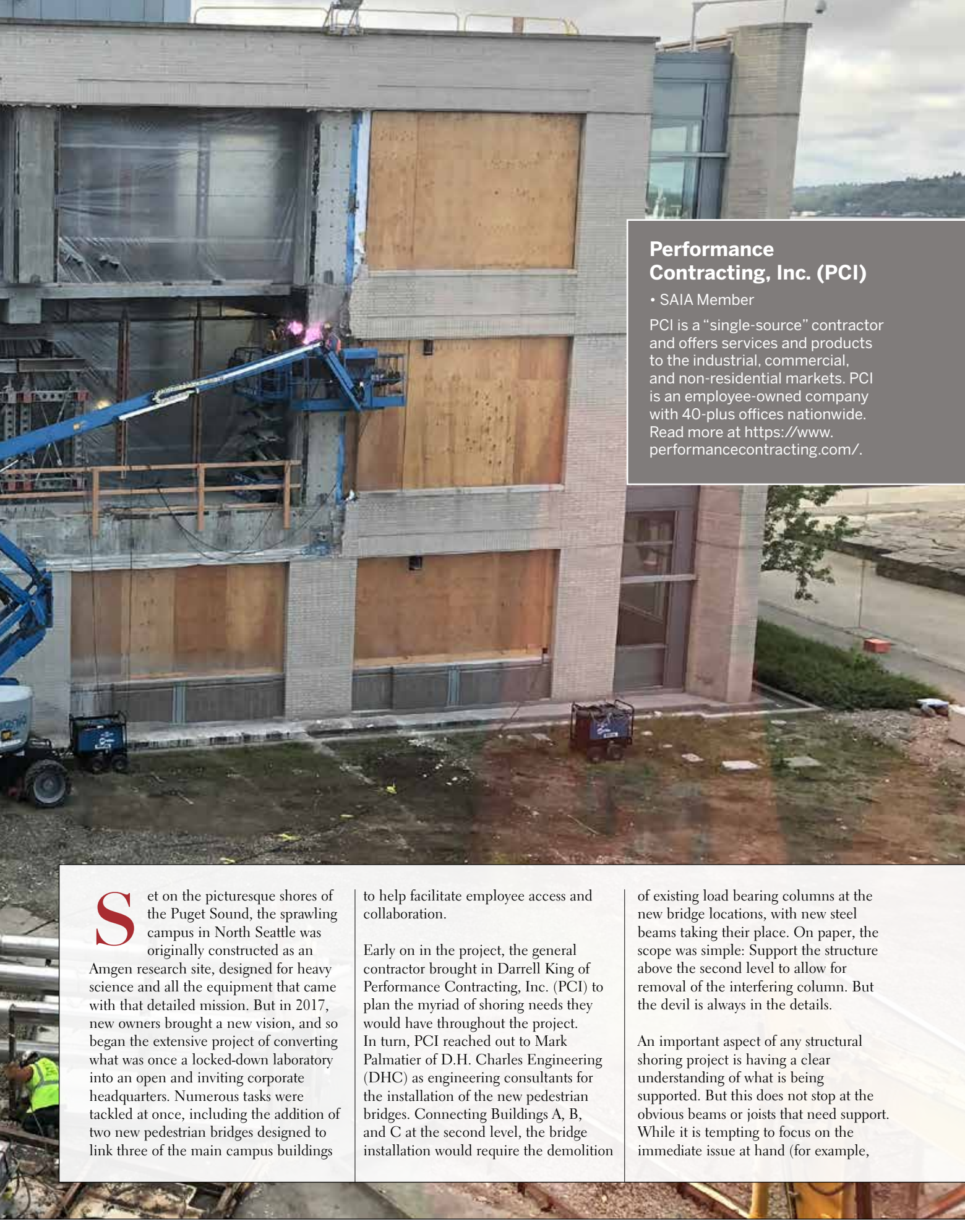
FEATURE



DISTRIBUTING THE LOAD SAFELY

A MULTI-LEVEL RENOVATION WITH TIGHT SPACING REQUIRED A COMPLEX SHORING DESIGN.

BY MARK PALMATIER



Performance Contracting, Inc. (PCI)

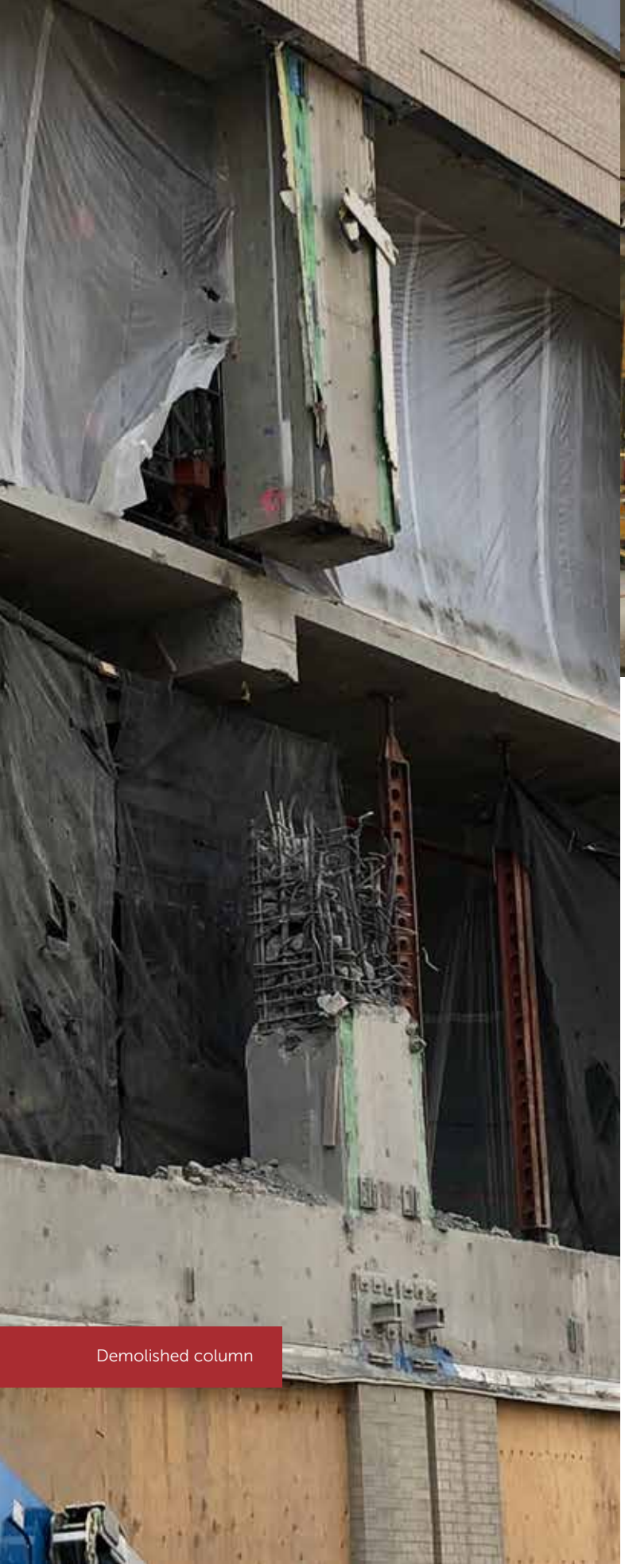
• SAIA Member

PCI is a "single-source" contractor and offers services and products to the industrial, commercial, and non-residential markets. PCI is an employee-owned company with 40-plus offices nationwide. Read more at https://www.performancecontracting.com/.

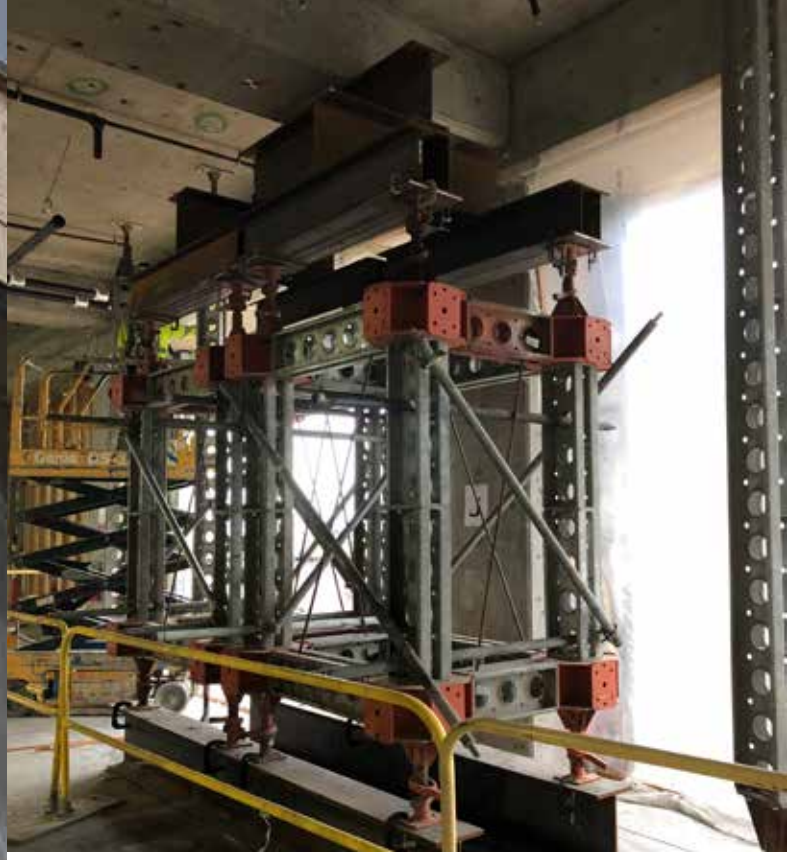
Set on the picturesque shores of the Puget Sound, the sprawling campus in North Seattle was originally constructed as an Amgen research site, designed for heavy science and all the equipment that came with that detailed mission. But in 2017, new owners brought a new vision, and so began the extensive project of converting what was once a locked-down laboratory into an open and inviting corporate headquarters. Numerous tasks were tackled at once, including the addition of two new pedestrian bridges designed to link three of the main campus buildings to help facilitate employee access and collaboration.

Early on in the project, the general contractor brought in Darrell King of Performance Contracting, Inc. (PCI) to plan the myriad of shoring needs they would have throughout the project. In turn, PCI reached out to Mark Palmatier of D.H. Charles Engineering (DHC) as engineering consultants for the installation of the new pedestrian bridges. Connecting Buildings A, B, and C at the second level, the bridge installation would require the demolition of existing load bearing columns at the new bridge locations, with new steel beams taking their place. On paper, the scope was simple: Support the structure above the second level to allow for removal of the interfering column. But the devil is always in the details.

An important aspect of any structural shoring project is having a clear understanding of what is being supported. But this does not stop at the obvious beams or joists that need support. While it is tempting to focus on the immediate issue at hand (for example,



Demolished column



must remove column, therefore must support beams attached to column), it is vital to take a holistic view of any demolition concept. What may appear to be a straightforward shoring project could become increasingly complex when having to consider the loads of upper floors. In the case of multi-level buildings, any column removed on a lower floor will have a direct impact on the floors above, magnifying and potentially multiplying the loads that need to be supported.

This became the case for the column shoring under design. During the planning phase, a preliminary load analysis of the columns slated for removal was performed to help quantify the weight the shoring would need to support. It was determined that, once the second-level column was demolished, the shoring would need to support the third level, fourth level, and all rooftop mechanical equipment in the project area, as well as a fifth-level penthouse structure. With all factors taken into account, the design team was looking at needing to support a shoring load of nearly 280 kips. Not only was this a significantly higher shoring load, it also opened up questions about the strength of the existing structure to support loads of this magnitude and whether reshoring of the lower levels was necessary.

Coordinating closely with the general contractor, the existing structure's Engineer of Record, and PCI, it was determined that the shoring loads would need to be reshored to grade to ensure the lower floors of the building were not damaged. DHC immediately began researching options for supporting a load of this magnitude within such a confined space. With overhead clearance varying from 14 to 17 feet between floors, cranes were not an option to aid in any heavy duty shoring tower construction. Additionally, due to the shoring being installed on the suspended slab of the second level, heavy equipment couldn't be used to aid in the tower placement.

Lastly, due to the need for reshoring, whatever method was used would need to be replicated on three separate floors, each with their own shoring heights. The main parameters were therefore refined down to three main goals: strong, maneuverable, and modular. Drawing on a long history in heavy shoring design and coupling it with experience in falsework and formwork design, it was determined that a system primarily aimed at bridge construction could be the key.

With PCI taking charge of procuring the components, DHC focused on addressing how to adequately support the structure. It was clarified by the general contractor during the demolition planning phases that not only would the entire column at the second level be removed, but an additional 12 inches would be removed from the base of the third-level column on the level above to make room for the new steel beam being installed. While this did not change the overall weight that would need to be shored, it drastically changed the distribution of the weight. Having the 12-kip column hang from the fourth-level framing meant shoring was now necessary to help support that floor as well. Moreover, this high load hanging at the very end of the beam being supported greatly magnified the loading applied to the shoring.

After analyzing multiple shoring scenarios, a multi-tower and multi-tiered shoring system was determined to be the best solution. To help distribute the shoring load, two shoring towers were installed at each shored level. Not only did this solution aid in keeping a single tower from being overloaded, it also helped to keep deflection of the shored beam to a minimum. Once below the levels being directly shored, reshore towers were installed to transfer the collected load down to the basement slab on grade. Faced with the limitations of the working area, DHC worked closely with PCI to ensure the steel shoring beams were as strong as necessary but as light as possible. In some cases, two smaller, lighter beams were deemed a better solution over a single heavier beam due to the difficulties of moving material inside the building.

Ultimately, after months of planning and coordination, the shoring installation went smoothly and according to plan. The modular variability of the components allowed for the towers to be installed in each floor as anticipated with minimal adjustments. At the slab edges, cuplock scaffolding was installed as an additional safeguard to prevent any shifts of the exterior façade due to the demolition, again highlighting the versatile nature of modular scaffolding components.

Throughout the operation, from planning to the installation and on to the critical moments of demolition, the clear component that was the common denominator to the project's success was clear communication. Without clear goals and requirements from the general contractor, PCI and DHC would not have been able to make key decisions on equipment. Without concise and frank discussions on equipment and feasibility, DHC and PCI would have never been able to settle on a shoring design that was both safe and efficient, which is always the ultimate goal.

About the Author

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