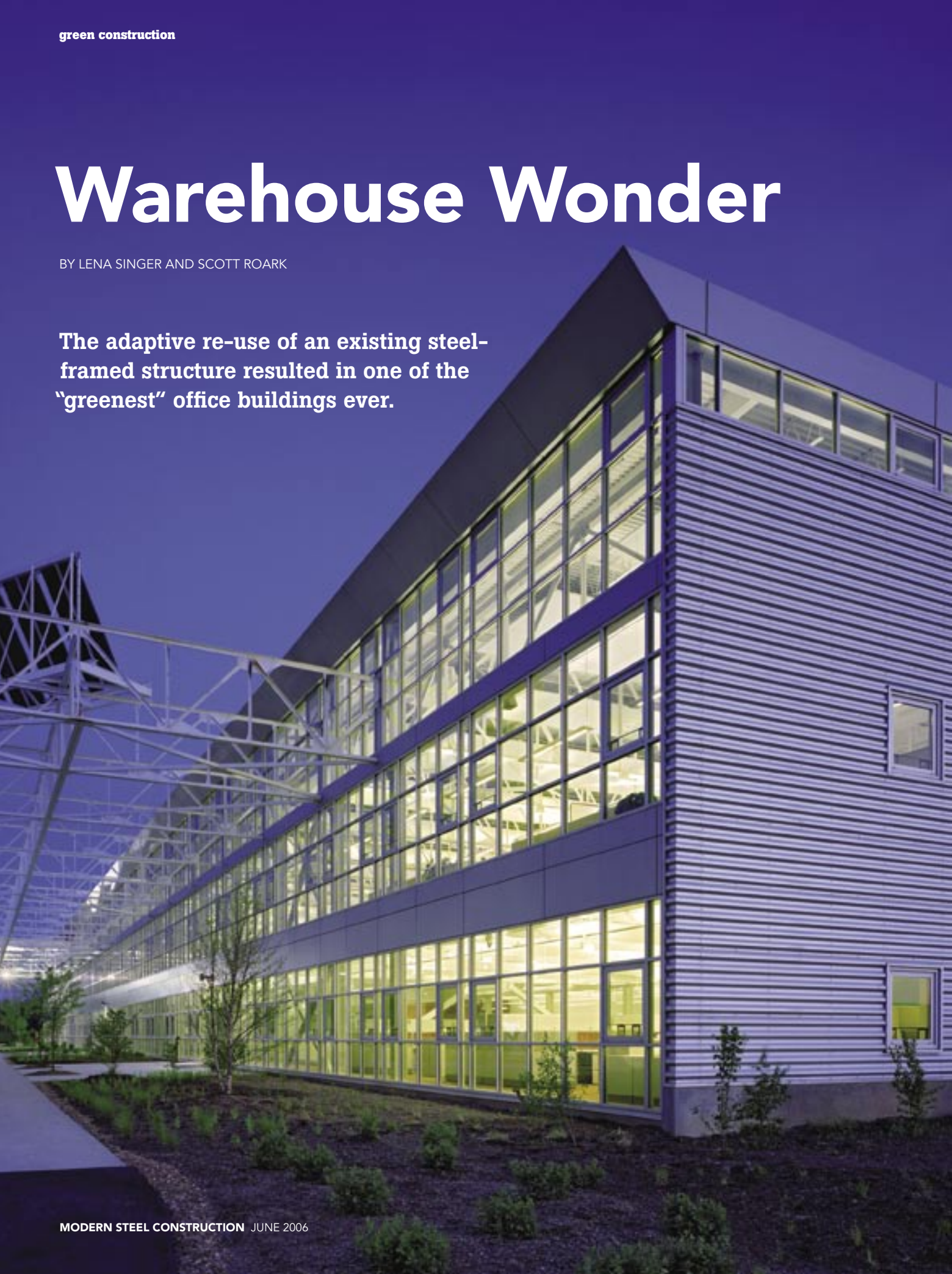
Warehouse Wonder

BY LENA SINGER AND SCOTT ROARK

The adaptive re-use of an existing steel-framed structure resulted in one of the "greenest" office buildings ever.



AN ABANDONED STEEL-FRAMED WAREHOUSE WAS TRANSFORMED INTO ONE OF THE NATION'S MOST ENVIRONMENTALLY RESPONSIBLE CORPORATE OFFICE COMPLEXES. The $20.1 million headquarters—constructed outside St. Louis for Alberici Corporation, a Midwestern construction and construction services company—received the highest score on record under version 2.1 of the U.S. Green Building Council's Leadership in Energy and Environmental Design certification program. The project is one of only eighteen in the world to receive a LEED platinum rating from USGBC.

Adaptive Reuse

More than 45 sites and structures were considered for the project. The owner and design team selected the 1950s-era warehouse largely because of the 505'-long 70' and 90' clear span bays provided by its original steel frame. The existing steel columns carry steel rails that were once used for the warehouse's crane operations. The warehouse's roof was constructed of open-web steel joists that offered 28' clear heights from the trusses' bottom chords.

Structural steel was a leading point-scorer in earning the headquarters' platinum rating (LEED v2.1), earning the project points from a structural and material standpoint. Steel's flexibility made it possible for engineers to reuse 95% of the warehouse's original structure in the new structural design. And because steel is a recycled material, the structural steel that was brought into the project contributed to earning the project two additional points for recycled content.

Architects took advantage of the warehouse's generous bays and 150,633 sq. ft footprint to create 108,586 sq. ft of new office space. A steel-framed "saw tooth" design was created for the office's exterior walls to reorient the building, which had faced southwest, to essentially face south. This allows more daylight into the office spaces while providing ventilation and relief from direct afternoon sun.

The complex also includes training rooms, a cafeteria, exercise facilities, and a parking component. The 116,747 sq. ft parking area was designed within the northern two bays of the original steel frame—a location that protects the office component from northerly winds. This also minimized the amount of pavement on the site, which, combined with the 90% light-reflective roof that now covers the parking component, minimizes the "heat island" effect on the campus. The roof deck of the next bay was removed to create a courtyard between the parking area and offices and to improve light and ventilation for both.

Combining Old and New

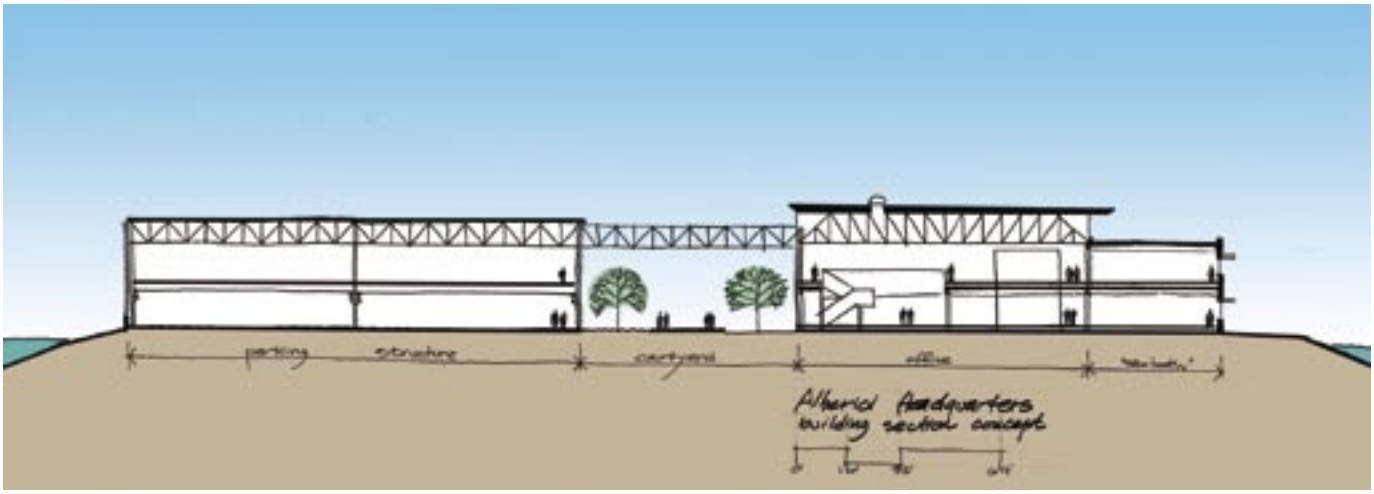
This interaction between the new and existing structure within the warehouse's shell created complexities in the headquarters' structural design. The warehouse's original columns were retained and ranged from W12×53 to W12×106. Columns for the new construction were provided by Hillsdale Fabricators, an AISC member and a division of Alberici. This steel had been acquired by Hillsdale for other projects but was never used. The sizes and shapes ranged from W10×33 to W10×68 and contributed to the project's points for recycled content.

The office component includes only three enclosed offices—the rest of the space has an open arrangement that is organized around three atria, with minimal use of fixed walls. Architects inserted a mezzanine level within the office area that was set at the same elevation as the parking area. This provides flexibility to connect the two components to expand the office area in the future, if necessary.

Structural engineers Alper Audi, Inc. had to integrate the gravity and lateral design of the existing construction with the new construction, which presented one of the project's most significant challenges: making certain the new structural elements did not exceed the gravity and lateral capacity of the existing structure.

The lateral capacity of the existing structure was tested in relation to current building codes and met the strength and drift requirements. The original crane rail beams were W21×62 and W33×130, while roof beam and girder sizes ranged from W10×17 to W24×55. This original design had supported the warehouse's crane operations, so its strength capacity was adequate for the reuse.

Structural engineers were able to use the crane rail beams to support new construction, as well, in both the office and parking structure. The beams were reused as girders for the office's composite floor. In the parking component, they were used to support the pre-cast double tee parking deck—the rails had the appropriate load carrying capacity and were in compatible locations in relation to the warehouse's existing steel columns. Connections were removed and the beams were moved to new locations and welded



A parking area is located in the two north bays (on the left, above) of the original building. The roof deck of the next bay was removed to create a courtyard that provides light to office component of the campus (on the right, above).

The courtyard created by removing the roof deck from one bay is visible in this aerial photograph.

Going Greener

The project team for Alberici's corporate headquarters worked together to incorporate an extensive range of "green" upgrades into the headquarters and its 13.59-acre site:

- 95% of the demolition materials from the original warehouse were recycled.
- Local and regional materials were used extensively, with 57% manufactured locally.
- The site's water management plan includes two ponds that retain and filter rainwater. This catchment system eliminates the need for potable water for sewage conveyance.
- Solar panels supply 90% of the building's hot water needs.
- A 125'-tall recycled wind turbine supplies the headquarters with 20% of its electrical power.
- HVAC controls automatically monitor carbon dioxide levels and introduce fresh air into the interior. Clerestory windows open automatically when weather conditions permit.
- The parking structure's roof is covered with a 90% light-reflective, soy-based membrane to decrease short-wave heat radiation.
- The project is located on a "brownfield" site, which, according to the Environmental Protection Agency, is a property where a hazardous substance, pollutant, or contaminant is present or may be present. Mackey Mitchell and Alberici worked with a local nature preserve and botanical gardens to restore the site and introduce native, drought-resistant plants.
- Two-hundred fifty native trees and 4,200 native perennial plants and bushes were planted on the site, which generates enough seeds to serve as a seed bank for St. Louis-area non-profit and government organizations.

—Information provided by Mackey Mitchell Associates.

Mackey Mitchell offers practical suggestions for sustainable design and construction that can be applied to a wide range of projects in the booklet "Think Green: 25 Ways." This booklet is available by e-mailing Kathy Ulkus at kathy_u@mackeymitchell.com.

into place on the existing columns. Existing connections were reused where possible and new connections were constructed where required.

The new component's lateral loads did require concentrically braced frames, however. The new steel composite floor beams and girders, ranging from W12×19 to W24×55, reduced the unbraced length of the existing columns and offered gravity capacity beyond that provided in the warehouse's original design. Steel columns and foundations were also added to relieve the load produced by the new construction. A raised floor system was used throughout the office area to accommodate an air distribution system and wiring for the mechanical and electrical systems.

An expansion joint was created to meet current fire code requirements for office buildings. A new truss for the expansion joint was designed and constructed to match the existing steel trusses, which are architecturally exposed in the headquarters' design. Steel erection drawings from the existing warehouse were used to determine the member sizes of the original trusses, which had been constructed of double angles and plates. This allowed structural engineers to use new member sizes that would approximately match the existing sizes. The new truss is visually identical to the adjacent existing truss.

Construction

The project required extensive teamwork among the architect, structural engineer, and Alberici as the owner, contractor, and steel fabricator. Structural engineers were completing their design and drawings in unison with the production of the architectural drawings. The detailing and fabrication of steel for completed sections of the new structure was underway while design of other parts of the project was being completed.

The design team worked directly with Hillsdale Fabricators to generate details for the stock sizes used in the new construction, which accelerated the fabrication schedule.

Hillsdale detailed and erected the new steel shapes to easily integrate within the existing steel structure. A standard connection was not possible, however. The link between the existing and new structures led to many different conditions that required a variety of connections, including shear tabs, double-angle bolted connections, double-angle welded connections, and gusset plate connections at new chevron bracing.

Exposed Steel Aesthetic

Architecturally exposed steel provides a prominent architectural theme for the headquarters. Nearly 100% of the existing steel structure—and a large part of the new steel structure—is architecturally exposed in the headquarters' interior and exterior.

The original open-web steel joists were painted white and left exposed throughout building's expansive corridors. The steel roof deck between the parking and office components was removed and existing steel joists were left in place and exposed. These joists cover a new 33,872 sq. ft courtyard that provides natural light and ventilation to the office and parking structures. MSC

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The steel-framed "saw tooth" design of the exterior walls was created to reorient the building, which had faced southwest, to essentially face south. This allows more daylight into the office spaces while providing relief from direct afternoon sun.

Owner
Alberici Corporation, Overland, Mo.

Architect
Mackey Mitchell Associates, St. Louis

Structural Engineer
Alper Audi, Inc., St. Louis

Engineering Software
RAM Structural System
Enercalc
RISA-2D

Fabricator, Detailer, and Erector
Hillsdale Fabricators, an Alberici Company, St. Louis, AISC member

General Contractor
Alberici Constructors, Inc., St. Louis

Exterior photos: Debbie Franke
Interior photos: Alise O'Brien
Drawing and aerial photo: Mackey Mitchell Associates