LEEDing the Way

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The first two buildings of a “green” office development in Lenexa, KS demonstrate the viability of sustainable construction principles.

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EcoWorks Phase 1, Buildings One and Two, are the newest buildings located within the Southlake Technology Park in Lenexa, KS. Owned and developed by The Zimmer Companies, the first two EcoWorks buildings comprise approximately 130,000 sq. ft of office space. Plans call for four more buildings to be constructed in the EcoWorks development, bringing the total leasable office space to approximately 395,000 sq. ft. EcoWorks is the 23rd building to receive the LEED™ (Leadership in Energy and Environmental Design) certification from the U. S. Green Building Council (USGBC) and has the distinction of being the first LEED™-certified speculative office building in the United States.

DESIGN CRITERIA

Environmental and ecological sensitivity were primary design criteria for the projects. The choice to develop EcoWorks as a LEED-certified building was a conscious business decision, says Hugh J. Zimmer, Chairman/CEO of Zimmer Companies. Zimmer believes that people who work in "green" environments can be be more productive because of their connection with natural light, cleaner air, and knowledge that they are part of an effort to conserve natural resources. EcoWorks also had to be cost competitive. The selection and design of materials placed great emphasis on meeting that goal.

The EcoWorks program required efficiency, flexibility and focus on environmental sensitivity in order to achieve LEED certification. The project incorporated items such as on-site ponds for water conservation; wind turbines and battery banks for the generation and storage of auxiliary power; and efficient lighting and mechanical systems. Innovative, white roof membranes and window shades helped reduce the use of energy resources and provided a comfortable office environment. A two-story 4,700-sq.-ft atrium is a gathering space shared by tenants of both buildings. This key element is situated between Buildings One and Two, but is structurally independent from them. Exposed structural steel is prevalent in the atrium and in each building's entry lobby.

Architectural, financial, and sustainability requirements drove the basic structural system for the buildings. Speculative office space needs to have an open, unfettered floor plan, so reducing intrusive x-bracing was important. Keeping floor-to-floor heights reasonable to reduce the amount of building-envelope material was another key design issue. Early contractor involvement in the project also allowed for the basic structural material to be evaluated. Structural steel fulfilled many architectural requirements, and as a result, was the contractor's material of choice in the local construction market.

EcoWorks' Building One is a two-story building that is 330′ long by 120′ wide. Building Two is a one-story facility that is 360′ long by 106′ wide. Each features an expansion joint within the facility, and between the buildings and the atrium. The exterior envelope is a combination of precast and E.I.F.S. on cold-formed metal framing. Early in design, multiple bay layouts and floor-framing schemes were identified and evaluated based on the amount of material and cost. Floor live-load capacity was 100 psf instead of the code minimum loads. This provided a more flexible, higher-capacity office space for the owner. Column bays, 30′ by 30′ and 30′ by 40′, were evaluated using both a composite steel beam-and-slab system and a non-composite, slab-on-steel bar-joist system. A wood system composed of structural joists with a steel lateral frame was also considered.

For the structured floor of Building One, a 30′-by-40′ bay layout with a composite slab was chosen. The composite floor system composed of a 6½"-deep lightweight slab on W18×35 typical beams at 10′ on center, with

The roof structure for both buildings is composed of 26"-deep bar joists at 6' centers on 28"-deep joist girders. The one-story Building Two uses 8" square HSS columns.

W21×50 exterior and W24×55 interior girders would cost less than a bar joist system with a thinner slab and members at 2', 6" on center. In the context of green design, the composite slab with structural steel beams provided the shallow structure the architect desired, with members made from primarily recycled steel content.

The roof structure for both buildings is composed of 26"-deep bar joists at 6' centers on 28"-deep joist girders. The one-story Building Two uses 8" square HSS columns, and Building One uses W10×45 and W10×68 columns. These elements play a key role in the buildings' lateral system, eliminating the need for x-bracing. Moment connections of the joists and joist girders to the columns were made to create moment frames in both directions in Building Two. Design end moments for the joists and joist girders were outlined on the drawings.

In Building One, the interior columns are oriented with the strong axis parallel to the short side of the building. The exterior columns are oriented with the strong axis parallel to the long side of the building. Therefore, moment connections of the floor beams to the columns are made only to the flanges, avoiding the application of lateral moments to the columns in their weak axes.

The atrium exists as a separate structure from the two buildings. It is composed of a glass curtain-wall system outside of an exposed structural-steel moment frame consisting of W16×67 columns and W24×68 beams typical. Steel members made to resemble tapered W-shapes were used to support an exterior glass-canopy system above the entries. These exposed steel supports, built from welded steel plates, are also used at the entry vestibules of the adjacent buildings. Stitch welds were ground smooth and areas between the welds were filled to give the appearance of an homogeneous member.

The architect's design called for the exterior precast of the adjacent buildings to become interior precast on the sides of the building adjacent to the atrium. During construction, the two office building frames were erected and the precast exterior was installed. Then, the steel columns and beams of the atrium were erected. The steel was not specified to be fabricated in compliance with architecturally exposed structural steel, but member sizes and connection details were derived with appearance in mind and were approved by the architect. Structural steel fit perfectly with the desired clean look and openness to natural light.

IMPACT OF STEEL

Steel is used throughout these structures as a means to achieve architecturally appealing and flexible structural performance. In the office spaces, the ceilings are exposed, reducing the amount of finish material and focusing attention on the exposed steel structure. Reframing the structure during the design process to accommodate the evolving design was easily accomplished since structural steel is so adaptable.

Specifying steel was also an important component in the LEED certification process. Environmental benefits of using structural steel for this project

were reduction in the amount of total material required and the amount of material used that was recycled.

The LEED-certification application acknowledges the importance of using recycled and locally available materials in order to conserve energy and avoid pollution associated with shipping materials. EcoWorks used approximately 515 tons of structural steel, and of that amount, 90% was recycled material. 100% of the steel joists was recycled post-consumer material, and steel deck was made with 20% post-consumer content.

One concern in green design is to use building materials efficiently. This was accomplished in EcoWorks Phase 1 by:

- proper design and documentation on construction documents;
- moment connections of joists to columns, which saved material for x-bracing by utilizing plates at columns that are required as stabilizer plates (and meeting OSHA requirements); and
- selection of composite steel framing, which reduced the number of members and decreased field erection time (over a steel joist system).

An important aspect of sustainable design is the commitment of the owner and design team to address environmentally sensitive issues, to search for innovative solutions, and to acknowledge how other systems (such as mechanical systems) can make a building more "green." The architect held regular meetings to chart the progress toward LEED application. The structural engineers studied LEED Green Building Rating System guidelines as they pertained to structural components and materials. And structural steel was used to respond to the needs of other disciplines and enhance the overall quality and sustainability of the buildings—contributing to this significant environmental success story.

Bret Busse, P.E., served as principal-in-charge and Scott Barney, graduate engineer, served as project manager on EcoWorks. Both work in Walter P. Moore's office in Kansas City.

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STEEL ERECTOR
Havens Erectors, Inc., Kansas City, MO (AISC member, NEA member)

ENGINEERING SOFTWARE
RISA 3-D, RAM Structural System

STEEL JOIST SUPPLIER
Vulcraft Joists, Norfolk, NE