Stone34, a LEED Platinum BD+C and O+M certified building located in Seattle and completed in 2014, embraced and met that challenge. Brooks Sports, a running apparel company, needed a new headquarters that could house their growing workforce. Brooks wanted this building to be a statement, a flagship building that would signal their dedication to sustainability and the outdoors.

**CASE STUDY STONE34**

**BREAKING THE TAPE**

(AND CONSTRUCTION MOLD) AT STONE34

BY MICHAEL HEDRICK, P.E., ASSOCIATE MEMBER ASHRAE, AND ADAM KLEIN

DESIGNING A NEWLY CONSTRUCTED, LOW-ENERGY USE BUILDING is certainly a challenge, but it’s one that many design teams across the country embark on every day. Guaranteeing the actual energy use of a newly constructed building with severe financial penalties on the line is a much more significant challenge—one that few teams pursue.
The company partnered with Skanska USA Commercial Development (Skanska USA CD) to be the anchor tenant of Stone34, a 140,505-square-foot mixed-use office building. Stone34 would be located in the Fremont neighborhood of Seattle, colloquially named the “Center of the Universe,” and situated alongside a major pedestrian and bike trail.

The team decided to pursue a pioneering certification process through the city of Seattle called the Deep Green Pilot Program (DGPP). This program offered the project a 15% increase in allowable floor area ratio (FAR) and an increase in the building height limit, in return for a guarantee to achieve—and prove, through utility bills—the following performance goals:

- A 75% reduction in energy use compared to the Seattle 2030 District water use baseline;
- A 75% reduction in energy use compared to 2003 Commercial Building Energy Use Survey data; and
- Capture and reuse of 50% of rainwater on site.

In addition, the building needed to fulfill 60% of the Living Building Challenge Imperatives, while meeting rigorous requirements for continued monitoring and verification. Failure to meet these requirements would have resulted in a penalty of up to 5% of the construction value of the project.

Each of the three major players in the project held a stake in this guarantee, including Brooks, Skanska USA CD (whose stake in

The dashboard, hung in the company’s bistro, gives near-real time updates on energy and water consumption.

The lobby features a kinetic art fixture titled Fissure that “blooms” when energy use is low.
Stone34 overlooks Lake Union in the Fremont neighborhood of Seattle.
the guarantee was bought out shortly after occupancy by a joint venture of Unico Properties and Laird Norton, and McKinstry, the design-build mechanical contractor who also managed the measurement and verification (M&V) of the building’s post-occupancy performance.

**Guaranteeing Performance**

Achieving Stone34’s performance targets required in-depth involvement of the M&V team during the design phase and engagement of the engineering team during the performance period. This approach differs from a traditional design-bid-build project where different entities are responsible for different portions of the project. One organization might do design and modeling, a second would construct the project, and a third might measure performance. This traditional approach makes the allocation of performance responsibility difficult.

In the case of Stone34, one company owned the responsibility for the design, construction, and performance monitoring. This bridged the gap between design intent and the real-world performance.

**Sustainable Systems**

Uniquely, Stone34 uses no on-site renewables due to strict permitting requirements and little roof area that could be allocated to renewables. To meet the aggressive energy targets, the project relied on a high-performance envelope, expanded comfort criteria, and highly interconnected and controlled mechanical systems. While no single element of the system is unprecedented, very few projects in the United States have combined these elements as part of a well-monitored and optimized system.

The building envelope includes R-40 roofs, R-18 walls, and high-performance low-SHGC glazing. The overall glazing percentage was set at a ratio of 37% window-to-wall and parametric modeling helped to balance energy performance and architectural aesthetics.

The mechanical systems at Stone34 are state-of-the-art. The mechanical plant includes condensing...
boilers, a heat recovery chiller, an oversized fluid cooler (for waterside economizer), a dedicated outdoor air system air-handling unit with heat recovery, and a phase change material (PCM) thermal storage tank. This plant serves a four-pipe hydronic loop to constant and variable volume air terminals, active chilled beams, hydronic fan coil units, and radiant slabs.

The primary energy-saving feature of the plant is that heat normally rejected from the chilled water system via the fluid cooler can be reclaimed and pumped into the building heating water system. This provides “free” heating when there are simultaneous heating and cooling loads at the plant.

The PCM thermal storage tank is filled with material that freezes at 55°F, allowing the chilled water system to operate at higher, more efficient, chilled water temperatures. Additionally, the presence of the thermal storage tank allows for additional hours of heat recovery operation, providing a cooling sink when there are only heating demands at the plant.

The plumbing fixtures are highly efficient, and captured rainwater is treated and resupplied for irrigation, mechanical system makeup water, and flush fixtures. Careful selection of plants and their layout also cut down on irrigation requirements. Rainwater is collected and drained to a 65,000-gallon cistern to be treated, then reused for non-potable services.

M&V engineers were critical in the design process to determine what energy and water metering infrastructure was required to complement and enforce the performance guarantee. The installed meters allow for lighting and plug load tracking by floor, water consumption by type of use.
and location, and gas use by piece of equipment. In addition to the extensive metering, many control points are also being tracked to visualize and verify building operations.

**Tenant Engagement**

None of this could have been possible without complete commitment from the tenant. The tenant, owner, and contractor participated in several annual energy “budget” negotiations to settle on targets that provided tenants flexibility within the bounds of the overall energy targets.

Although it wasn’t always easy, Brooks and the project team collaborated to find ways to engage their employees in energy and water reduction. Employees received visual feedback on their progress, including a dashboard hung in the company bistro that shares real-time energy and water consumption. There is also an art fixture in the lobby that

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**Figure 3A** RUNNING SUM OF ACTUAL TOTAL ENERGY USAGE

![Figure 3A](image)

**Figure 3B** MONTHLY ACTUAL TOTAL ENERGY USAGE VS DGPP TARGET

![Figure 3B](image)

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Much of the landscaping is edible, and all is watered by rainwater captured onsite.
**Lessons Learned**

**Performance contracts**, where the project team is held to energy and water performance guarantees established during design, are beginning to see more widespread use. The challenge is to align each party’s interests with those of the building, from design through the performance verification period. Here are some helpful suggestions:

- **Include financial contractual obligations** for the total building performance to key contractors and subcontractors whose actions can make or break the building’s performance.
- **Include all relevant parties** (e.g., owner, tenant, modeler, designer) in negotiations about tenant performance lease requirements early. Providing complete transparency in any supporting calculations and documentation helps establish clear targets and trust.
- **Buildings with complex control systems are difficult to accurately commission** prior to occupancy. A review of the building automation control system programming by the design engineer and commissioning agent together can provide significant value.
- **Expect the unexpected**. Something (or many things) will be different than the design team anticipated. An engaged measurement and verification team is critical to identify and troubleshoot issues quickly, and the design and construction teams need to stay committed to the project through the end of the performance period.
- **Four minutes is just too little time** to comfortably shower when the water temperature needs some time to settle.
- **Dashboarding isn’t enough**. Software programs that create custom visualizations tailored to your specific building show exactly how the building is performing at the systems level—and identify potential risks or issues.
- **Sort through the noise of the data**. The team had the metering capability to track a massive amount of building data, but only a sliver of it gave insight into the building’s actual performance.

“blossoms” when energy use is low and “wilts” when energy use rises.

As part of the low energy use goal, the team decided early on to widen typical design conditions in the office spaces by using a summer indoor temperature set-point of 78°F and a winter indoor temperature setpoint of 70°F. However, despite design team and tenant planning, 54 temperature complaints and concerns were received during the first summer of occupancy. After these initial complaints, occupant training and optimized mechanical system operation reduced the quantity of complaints down to 11 in the following year.

Brooks estimated that half of their staff would shower every day, which was modeled to take up a significant amount of the water budget. Each shower is controlled by a timer that shuts off after four minutes of use. This was an unusual approach, and occupant reaction was mixed. Later in the year, the team agreed to lengthen the shower timers as it became clear that the number of showers did not pose as great of a risk to the energy and water targets as initially predicted.

Brooks also turned to smart plugs to find how they could save energy at each employee’s workstation. During the first three months of occupancy, Brooks gathered data on the behavior of employees and used sample stations to test time-based and smart rules to control power. Once the team had a strong understanding of how to best implement their smart plug strategy, they implemented device logic that immediately reduced plug load by approximately 60%.
Benefits of Energy Management

Due to the large financial penalties riding on the outcome, real-time performance tracking was critical to making operational changes after occupancy. Design engineers, the M&V team, the tenant and the property managers met regularly throughout the one-year performance period.

Building monitoring came online in mid-October 2014, and within two weeks the M&V team identified abnormally high gas use at the building level and attributed it to central heating plant operations. To address the higher-than-expected gas use, the M&V team set up a series of data visualizations to help understand when and how central plant equipment was operating.

Less than two weeks later, the engineering, M&V, and controls teams had identified the root cause (a faulty control sequence), achieved consensus on a solution, and implemented changes to the central plant controls to address the issue. The gas usage reduced dramatically and proceeded to perform well below the modeled target afterward.

The Results Are In

In the first 12 months of occupancy, the building finished the performance period by beating the energy use target by 12.5% at an EUI of 27 kBTU/ft²/yr, domestic water use target by 18.2%, and rainwater re-use target by 1.1%. Compared to similar buildings, the energy use is 78.9% lower and domestic water use is 81.7% lower.

After a third-party review and complete audit report by the International Future Living Institute, the city of Seattle officially notified the Stone34 project team in August of 2016 that the building had met the DGPP energy, water, and sustainability requirements.

The project’s success relied on a number of factors. The team was integrated and committed to working together, with a strong emphasis on measuring and verifying performance during operation. Key team members were contractually bound to the measured performance of the occupied building. The team provided building occupants tools to track and understand how their use of the building contributes to performance, and incentivized them to embrace the project goals as an equal partner.

Of note, when Stone34 was sold soon after Brooks moved in, the joint venture purchasing it also assumed the risk of the energy and water guarantees—direct evidence that, given the right incentives, developing extremely low-energy buildings in a competitive marketplace is good business.

ABOUT THE AUTHORS

Michael Hedrick, P. E., is a lead engineer at McKinstry and a member of the Stone34 design team. Adam Klein is an energy analyst at McKinstry and a member of the Stone34 measurement and verification team.
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