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“SMOOTH OPERATORS”

Lowering a Building's Energy Tab with Building Commissioning

By Mary Kremposky, Associate Editor

Before launching its ships on the high seas, the United States Navy systematically inspects and tests its vessels in a process called commissioning. More than 30 years ago, a flood of ex-Navy personnel entered the building industry and began tackling construction with the same analytical fervor, according to Philip G. Saoud, PE, vice president, assistant director of contract administration/commissioning for Troy-based Peter Basso Associates Inc, in describing the rise of building commissioning. Whether on stormy seas or in a difficult marketplace, no one wants a structure to operate at less than peak efficiency. In today's sink or swim economy, building commissioning now delivers energy-efficient, smoothly operating buildings with lower utility costs for the owner and reduced warranty costs for contractors, plus a host of other benefits. A growing number of building owners and developers simply won't launch a construction project without it.

Horizon Engineering Associates, LLP commissioned the following systems for the University of Michigan Cardiovascular Center: heating, air conditioning, electrical, plumbing, fire protection, medical gas, nurse call, security, and lighting controls.



Peter Basso Associates, Inc. delivered the benefits of building commissioning to the Detroit Public Schools' Detroit School of Arts.

Saoud defines building commissioning as “an organized process to verify and document that a building is performing in accordance with the design intent.” This systematic process scrutinizes, tests, analyzes and documents the host of unseen systems that heat and cool office cubicles, ventilate auditoriums, and in general regulate a building’s energy appetite. According to Matthew Tunnard, PE, CCP, LEED AP, senior engineer for the Michigan regional office of New York-based Horizon Engineering Associates, LLP, building commissioning typically covers the inspection and validation of the building’s interior systems. These systems include MEP - the mechanical, electrical and plumbing systems that usually account for about one third of a building’s total cost - as well as

fire protection and any innovative wastewater technology or alternative energy system in an environmentally friendly building.

The main advantage: A properly commissioned building will seldom be “out of commission”. Said Tunnard, a former facilities manager, “The commissioning process brings so many positives to the project. When I first encountered commissioning, I thought, ‘This just makes too much sense.’ The owner loves it, because they have an efficient building that works and that is saving them money. The contractors are usually very happy, because we helped them make money through a reduced punch list and warranty costs. The construction managers love it, because we make them look good by helping them finish a pro-

ject on time. When people buy into the process, it helps everybody.”

Added Saoud, “People are seeing the benefits of commissioning on all types of buildings. We used to have to explain to owners what commissioning was, and now we have gotten to the point where owners request commissioning on projects.”

A POSITIVE PAYBACK

For owners, financial benefits are concentrated in the energy savings gained from this systematic scrutiny of building systems. Horizon prepared an estimate of the cost saved per square foot for 17 buildings recently commissioned by its Novi office. “On average, we saved 39 cents per square foot on utility costs for these buildings,” said Tunnard.

Altogether, Horizon's recent commissioning projects in Michigan yielded \$454,000 dollars in estimated annual energy savings for approximately 1,154,000 square feet of space.

Thanks mainly to this blissfully lower energy tab, the payback period for investing in the commissioning process seldom exceeds two years, according to a Department of Energy study that tallied the payback period for buildings ranging from high-rise offices and computer facilities to medical buildings.

an energy-efficient facility to potential buyers."

This bonanza of energy savings can be gained through new building commissioning, re-commissioning, and retro-commissioning of existing buildings. In a new building, commissioning can discover malfunctions that may slip under the radar, almost invisibly increasing a building's energy consumption and invariably draining the owner's pocketbook. Even a malfunction as simple as a stuck valve can escalate energy costs. "In

money away from the bottom line. "The building owner may not even notice, because the building's utility and energy usage has been at this same level from day one," said Tunnard. "Commissioning can reduce costs by finding these types of conditions before the building opens."

A building's uncomfortable temperature may signal a problem, but at times systems unknowingly compensate for a malfunction, maintaining the proper conditions but leaving the building

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"Usually the larger the facility the more cost effective, but none of these have more than a two-year payback," said Tunnard. "The building owners who pay their own utility bills, such as hospitals, colleges, and school districts, tend to see the value of commissioning. I think more developers are starting to see the value of commissioning as a selling point offering a type of guarantee that the building works properly and offers

the summer, a hot water valve failing to properly close may heat incoming 80-degree F air to 90 degrees F, forcing the chiller to work harder to cool the air down to 50 degrees F," said Tunnard. The chiller must expend more energy and the building owner must spend more money on utility bills.

Without a baseline for comparison, the new building owner may never know about these invisible quirks siphoning

owner clueless about the drain on their energy costs. "For example, a damper stuck open may bring in 50 percent outside air rather than the 20 percent stipulated by the design," said Tunnard. "On a zero degree day, the building's hot water coil can compensate by just using more hot water to heat the incoming air. From a comfort point of view everything is fine, but the owner has no idea of the energy being wasted. The owner will



As shown above, improperly staged ductwork allows dirt to accumulate on the duct interior. By helping to prevent this and similar conditions, building commissioning boosts indoor air quality and improves the overall health of a building.

see it on their bill, except if it is a new building the owner may never even realize his building could be more energy- and cost-efficient."

Re-commissioning also aids the cause of energy efficiency. In re-commissioning, the owner enlists the services of a commissioning authority to review the performance and efficiency of a building two or three years after the structure's original commissioning. An unwarranted rise in utility bills may signal the need for re-commissioning, said Tunnard. Added Saoud, "Often equipment and systems get out of calibration or usage of a space changes, making it worthwhile to retest and make sure systems are still performing optimally."

Retro-commissioning inspects, tests, and sometimes alters systems in existing structures in operation for an extended period of time. "For example, retro-commissioning is used in the school or hospital that has been open for 20 to 30 years and whose owners are trying to reduce their energy usage," said Tunnard. Retro-commissioning evalu-

ates different components of the systems and analyzes the building's sequence of operations. "We might create a new sequence of operations that fit the owner's new design intent," said Tunnard. "For example, if the building originally had 5 percent outside air, the owner may want to increase outside air to 20 percent to improve their indoor air quality. We might help them create a new sequence of operations, then check and test its operation."

Jim Newman, CEM, CSDP, LEED AP, managing partner of Bloomfield Hills-based Newman Consulting Group, when talking to facilities managers on proper operating and maintenance techniques to reduce energy and improve indoor air quality (IAQ), is fond of saying, "An older HVAC system operated properly can many times outperform a newer system operated inefficiently." He also comments, "Quite often when we perform energy audits, we find many items that will lead to retro-commissioning of HVAC systems to improve energy performance as well as IAQ."

LEED TAKES THE LEAD ON COMMISSIONING

The U.S. Green Building Council (USGBC) has long recognized the energy benefits of building commissioning by requiring the process as a prerequisite or mandatory requirement for LEED® certification. "The USGBC's prerequisite recognizes that commissioning plays a key role in both energy efficiency and indoor air quality," said Saoud.

As a prerequisite, commissioning does not earn any credits in the LEED point system. LEED does offer a credit for enhanced commissioning, the USGBC's own term for commissioning beginning in the design phase and employing the services of a third-party commissioning provider. "The commissioning provider examines the design from an operations and maintenance point of view," said Tunnard. "They will analyze the sequence of operations and consider whether it is something that can be tested and if it meets the owner's needs. We are not there to design the building. Our job is to ensure that the design is built

and implemented correctly.”

Although the architect/engineer certifies the drawings and controls the design, the commissioning provider offers ideas in a collaborative team spirit. “It is very expensive to fix a problem once it is built into the building, so if you catch it in the design phase or early in construction that is the most cost-effective time to fix a problem,” said Saoud. “Ideally, we would get involved during the schematic design phase of the project.”

Linked to LEED, building commissioning has been growing along with the rise of LEED-certified buildings. “LEED began catching on about five years ago,” said Tunnard. “LEED has probably been one of the biggest factors in the growth of commissioning.” For example, half of a major retail chain’s stores opening in 2008 are aiming for LEED certification with all of their future stores beyond 2008 vying for the coveted certification. “The retailer’s LEED-certified stores opening in 2008 will all be commissioned as a LEED prerequisite,” said

Saoud. “But even the stores of this major retail chain that are not LEED certified are asking for commissioning.”

Newman, an experienced LEED professional and an active member of the USGBC, having been the LEED project administrator on many different types of buildings, comments that “the additional LEED credit for ‘Enhanced Commissioning’ adds additional activities beyond basic commissioning to benefit the owner. These consist of several items, the most important of which are verification that the requirements for training operating personnel and building occupants are completed, and the requirement that the commissioning agent return to the project within 10 months after substantial completion to review the operation of the systems with the operating and maintenance staff and building occupants. If there are any outstanding commissioning-related issues, these are resolved with the assistance of the affected contractors before the first year warranty expires.”

Commissioning may grow on state-

funded projects, because as of about a year ago, the State of Michigan began requiring state-funded projects to meet the intent of LEED. “The State isn’t requiring LEED certification, but the State wants to make sure state-funded projects are at least in accordance with the overall intent of LEED, which includes commissioning as a prerequisite,” said Saoud.

Saoud traces the rise of building commissioning after its launch in the U.S. Navy thirty years ago and its emergence in its current form a decade ago. Commissioning first infiltrated highly technical buildings, such as research laboratories, before spreading into university facilities, including Wayne State University and The University of Michigan, which has its own in-house commissioning department but enlists the services of commissioning providers due to the high volume of university facilities, said Saoud. In the past decade, the protective umbrella of commissioning has expanded to encompass K-12 schools, hospitals, and other medical

A STEP-BY-STEP OVERVIEW OF BUILDING COMMISSIONING

Tunnard describes the steps of the ideal commissioning process for a new building. Ideally, the commissioning provider joins the project team in the design phase to better assist in translating the owner’s needs and the design intent on the jobsite. Pinpointing issues early translates into an easier and less costly alteration.

- **Submittals** – The commissioning authority helps determine that the submittals are indeed what is specified to again protect the owner’s needs and the design intent.
- **Equipment** – The commissioning authority makes sure the equipment ordered is the equipment that arrives on site. “We’ve had switch gear

arrive on site that was supposed to go to a job down the road,” said Tunnard.

- **Pre-functional Checks** – The commissioning authority checks every facet of the equipment and various systems to help ensure every component is ready for operation. “Using a pump as an example,” said Tunnard, “we check that the pump is set correctly. We check the rotation of the pump to make sure it is spinning in the proper direction, and we check that all the thermometers and pressure gauges are on the pump and ready to operate.”
- **Functional Testing** – The commissioning authority inspects to make

sure the whole system is operating as designed. “Using the pump analogy, the mechanical contractor hooks the pump up, the electrician brings power to it, and the control contractor might hook a pressure gauge to it,” said Tunnard. “We check that the pump is controlling to speed, is maintaining the proper speed or temperature, and we analyze how the pump fits into the whole system. ... We go through the entire sequence of operations devised by the engineer. When the temperature drops to a certain degree, we watch how the boiler, hot water system and air handlers all work together to create a comfortable temperature. We look at the big picture.”



facilities. "Commercial and industrial buildings are probably the last to catch on, but we are now seeing an increase in those sectors within the last few years," said Saoud.

Only a few years ago, less than five percent of buildings were commissioned, estimates Tunnard. Today, both Saoud and Tunnard guess that roughly 10 percent of buildings are now commissioned. "We now see a rapid increase in requests for building commissioning proposals. We have commissioned over a hundred projects over the last 15 years, but we have commissioned as many as 20 this year alone," said Saoud. "It's a growing market, because the benefits are becoming clear to everyone."

LOWER WARRANTY COSTS

In the early days of commissioning, some mechanical contractors may have viewed the commissioning provider as an unwelcome inspector policing their project. Today, the image has shifted from inspector to partner as contractors reap the benefits of the commissioning process. "Commissioning can save contractors a lot of money if they buy into the process," said Tunnard. "We've had contractors thank us, and we've had contractors tell owners to hire us when they see how commissioning benefits them."

Commissioning is another tool to help deliver the job on time, aiding the construction schedule by identifying and resolving concerns as early as possible. Tunnard cites one of his favorite on-the-jobsite examples: An apprentice was preparing to attach water piping to the first heat pump in a row of 20 pumps. A commissioning provider noticed the pipe's trajectory would run directly through the center of the air filter's pull or handle. "That meant that no one could ever pull the filter out to clean the air filter, which would become a maintenance issue," said Tunnard. "The situation was fixed, and we saved the contractor three days of work – the time required to fix the problem if the apprentice had gone ahead with piping all 20 pumps the way initially planned. Plus, accessible equipment results in lower

maintenance costs for the owner."

The full benefits of commissioning – the systematic inspection, testing and analysis of building systems throughout the course of the project – are harvested at the end. "Commissioning can help contractors tremendously by reducing the final punch list to only a few items and dramatically lowering warranty costs," said Tunnard. "We systematically go through and check all systems. We know before the building opens and before the owner takes over the building that everything works. All the little calls that might arise – the building is too hot or it's too cold – drop tremendously. They don't go away, but they might drop from 50 calls to two."

KEEPING ON SCHEDULE

The commissioning provider helps the construction manager keep the schedule on track. "Commissioning helps maintain the construction schedule, because we try and resolve any mechanical construction issues as early as possible or avoid them all together, preventing them from becoming a road block later in the job," said Saoud.

Saoud also lists the benefits of commissioning to the architect/engineer. The commissioning provider conducts a thorough design review that aids in their job of ensuring the work is executed per the design. The commissioning provider acts as a type of interpreter between the blueprint and the team on the jobsite. According to Saoud, the commissioning provider works with the owner and designers in conducting a type of design and constructability review that reduces questions in the field, a condition benefiting both contractor and the design team. "We are not trying to influence the design, we are just trying to make sure that it is clearly communicated between all parties," said Saoud. Documents reviewed for clarity and completeness "prevent the contractor from having a lot of extras later on in the construction process. At the end of the job, we document and verify that systems are working per the design. This helps architects/engineers with an orderly close out."

The feedback in the field and in the meeting room is now generally positive. "When commissioning was new, I think people resisted or struggled a bit," said Saoud. "They didn't want to be involved in additional meetings and handle additional requirements. Most contractors and designers now have been through the commissioning process, and I think they have a good comfort level with it. They understand it actually helps them. It is not just a benefit to the owner; it is a benefit to them, as well."

AN OWNER'S MANUAL TO YOUR BUILDING

The project is over and the keys to the front door have been handed over to the owner. On a commissioned project, the owner not only has a new key on his key chain but a detailed maintenance manual for the building. "The owner has documentation that the building is operating correctly and they know the operating set points," said Saoud. "If they start to adjust something and the system becomes out of whack, they can restore it back to its original point. We also assist with a formal process of owner training that includes making sure the correct personnel are attending the training session."

The full benefit of commissioning comes to the forefront as the building becomes part of the daily life of an office staff, medical unit or school. Like plants in a greenhouse beautifully blooming under the right temperature, humidity and light levels, building environments with well-functioning systems allow the abilities of personnel to flower and companies to reach peak productivity. "Temperature control alone can dramatically impact the productivity of people in a building, an important factor since over time, the largest cost of a building is really the personnel," said Tunnard.

Newman adds, "The cost of energy and operating and maintenance in a typical office building ranges from \$2.75 to \$6.00 per square foot per year. If the average salary cost with fringes for an employee is \$40,000 per year, and that employee takes up about 200 square feet,

Peter Basso Associates commissioned Saginaw Valley State University's Pioneer Hall of Engineering and Technology. Shown at left, the supply air ductwork for a foundry hood at Pioneer Hall is part of an efficiently operating system that may serve as an inspiration to the engineers of tomorrow.



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the cost for that employee is \$200 per square foot per year. If the productivity of an employee can be improved by as little as 3 percent (and studies have shown that it can range from 3 percent to 20 percent in a well-designed and well-operated building), that \$6.00 per square foot per year is larger than the total of the energy and the operating and maintenance costs in most buildings. Imagine the profitability for the owner if the productivity increase is 10 percent!"

For property managers, a building offering the necessary creature comforts without a glitch and in an energy-efficient manner is a major selling point. "If you can demonstrate that your building has been commissioned and your tenants don't have comfort complaints that is certainly a selling point to a property manager," said Saoud.

Familiarity and necessity are converging to create a growing sector of the design and construction industry. A growing familiarity of the benefits of commissioning and the necessity of controlling energy costs are fueling the rise

and expanding the scope of the commissioning process.

"Usually once an owner goes through the commissioning process, they see the value of commissioning and they won't do another project without it," said Tunnard. "Some developers are seeing the value of commissioning. We've had good luck with developers on the East Coast who see that it has two benefits: it helps their schedule so they get to open on time, and it reduces their liability in terms of reducing the probability of people having indoor air quality issues. We've worked on high-rise residential units and it helps reduce liability from carbon monoxide poisoning and other hazards."

Over the last few years, the concept of building commissioning is even expanding to include total building commissioning. "Owners are starting to ask for architectural systems commissioning of the roof systems and the building envelope," said Saoud. "We even see commissioning of elevator systems and sometimes specialty systems in various

buildings.

New tools are even appearing to enhance the testing process. "We've seen requests for building thermography on commissioned buildings over the last two or three years," said Saoud. The required camera technology has become more cost effective and more accurate, fueling the rise in demand for building thermography, a technology with the ability to detect leaks in the roof and building envelope and to detect faulty connections in electrical equipment and panels.

Building commissioning itself is a sensitive tool using the knowledge of the commissioning provider, working with the project team, to systematically analyze, test, check and inspect the intricate and complex building systems supporting the equilibrium of our interior environments. For the owner, commissioning can help curb energy costs; for the wider community beyond the door of any building, it can help restore the balance and equilibrium of our global energy use. ☞



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