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NJARNG Sustainability Newsletter

In collaboration with Rowan University

Clean Cut Quarterly

Technology

The role of modern technology in facilities management. See page 1 for more details.

Tankless

Solar Heater

Photovoltaic

Learn how tankless water heaters are more efficient and the way of the future on page 3.

Solar heating or photovoltaic, which option is best for you? See details on page 5.

The Role of Technology in Facilities Management

By: Teresa Scronzynski and John Malaszecki

Today's Role of Technology

Facilities now are larger and more complex than they used to be. Managing them efficiently and effectively is harder to do, which is why there are many technologies nowadays to assist in their management. One piece of technology is monitoring sensors placed across the building's systems. This can include a simple system of occupancy sensors in rooms to turn off lights. There are more complex systems like a smart HVAC system which has automated temperature settings for the day and night or other times when the building doesn't need to be heated to a higher temperature. This can reduce the amount of work the system does and extend the life of the system, which will save money for the building owners.

Structures with a large number of complex systems are automated reminders for planned maintenance. Planned maintenance is the work that is done on a system to prevent its decay and damage of a system. When this is done, it creates a lower amount of corrective maintenance, reducing the cost of maintaining the building. The maintenance tasks that need to be done can be retrieved from the maintenance manuals of the systems or the standards used by the industry. Many softwares can be used to create automated reminders, which may already be built into the corrective maintenance systems.

Another piece of technology is Building Information Modeling, or BIM for short, systems. These are full detailed 3-dimensional models of the building's structure and the systems inside of it. These models include thermal qualities such as the insulation levels from the walls and the windows. They are very useful for helping to maximize space utilization and minimize energy consumption. They can also be linked with a maintenance system to assist maintenance personnel with planned maintenance.

'Role of Technology..' continued on page 2

Advances in Technology

Smart buildings provide a rapid and responsive environment through a combination of new technologies, automated controls, and previously logged data-based decision making. Through the use of sensors, combined with reliable cloud-based software platforms, the systems can be managed, automated, and controlled remotely 24 hours a day, 7 days a week. By using new advanced technologies, the Internet of Things (IoT) monitors environmental data, such as motion for security, temperature for HVAC, light for electric, and sensors for humidity, which all analyze the building systems' operational efficiency. These technologies optimizes facility operations in real-time by using data intelligence software. Buildings have one of the highest rates of energy consumption leading to a lot of constant investment being poured into facility maintenance.

A smart building combines granular data monitoring with advanced analytics, setting it apart from traditional BIM command and control solutions. Any aspect of your building's operation can be monitored using the Internet of Things. IoT sensors can be used to monitor power quality, conduct predictive maintenance, detect occupancy, and measure energy in all of your building's equipment (not just the major operational components). If you want to measure something specific, you can place them on ceilings/walls, pipes, any machinery or refrigeration units, doors/garages, windows, air ducts, desks, appliances, or anywhere that is relevant to what you are measuring for facility management. A detailed understanding of your building's performance will enable you to make targeted improvements that have a meaningful impact on your financial investment around facility maintenance & management.

If you're looking to improve your facility's efficiency while cutting down on costs associated with maintenance and operations - a smart building is an answer! By using granular data monitoring paired with advanced analytics, IoT sensors can provide real-time insights into everything from energy usage to alarm status - helping you streamline operations and reduce costs quickly and easily.

Save Space and Energy with Tankless Water Heaters

By: Walter Foard, Allison Garfield, Braden Garth, Colton Thomas, & Andrew Wilson

Increasing energy costs and threats from climate change make it important for individuals to put their foot forward and “go green.” There are plenty of ways citizens and businesses can become environmentally friendly and energy efficient. For example: solar panels on homes, electric vehicle use, and installation of efficient home/building technology, including water heaters. Tankless-water-heaters are the latest and most energy efficient way to provide homes and commercial properties with heated water.

Tankless water heaters, or “demand water heaters,” provide hot water by heating water as it passes through the heater. In contrast, storage-tank-heaters warm water in a tank, so that hot water is available to release. Due to heat loss, storage tank heaters must continually re-heat the water in the tank to maintain the desired temperature [3]. The tankless system only heats water when hot water is required, so energy wasted due to thermal loss is minimized.

‘Save space..’ continued on page 3

However, the rate at which a tankless water heater can supply heat is limited, and therefore the hot water flow rate is also limited. If the hot water demand is greater than the water heater can supply, the water will not be delivered at the desired temperature [1]. Figure 1 compares different energy sources and configurations. Gas-powered heaters typically can provide heat at a greater rate than electric ones [1]. Facilities with higher demands may implement either large-capacity water heaters or multiple small water heaters.

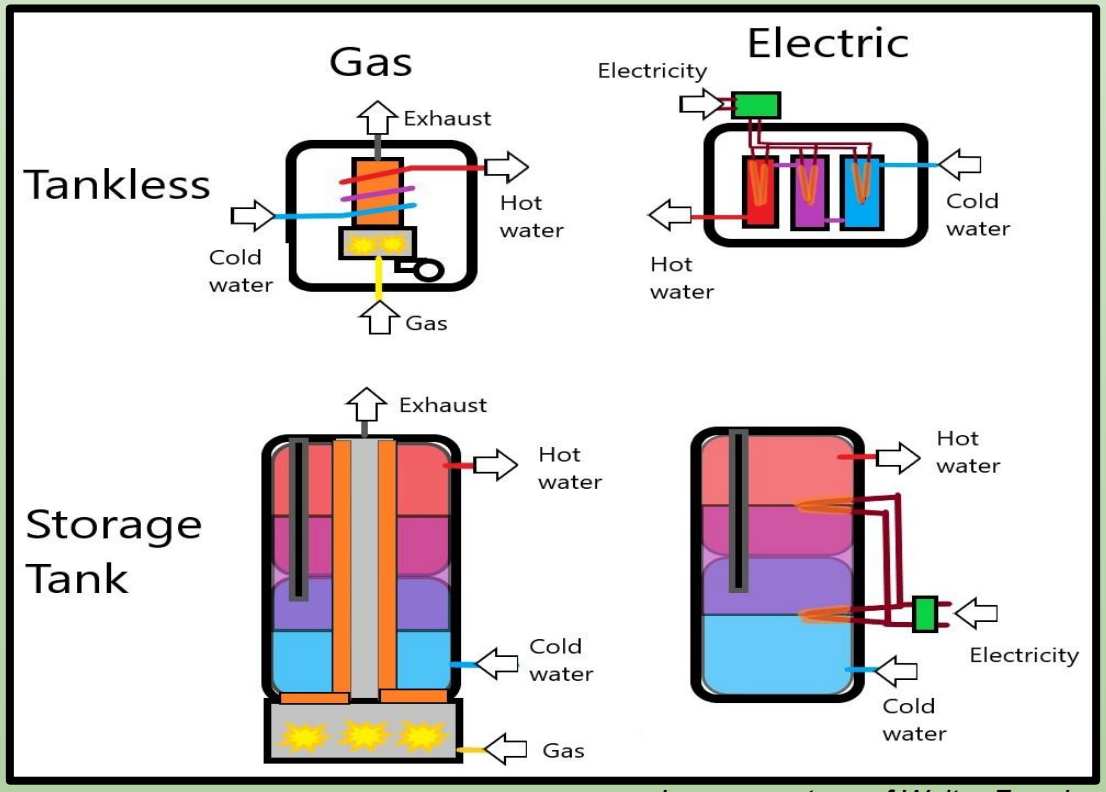


Image courtesy of Walter Foard

Figure 1. Function breakdown of tankless water heaters vs. storage tank water heaters.

From an energy use standpoint, tankless water heaters outperform storage tank water heaters. For hot water use of 41 gallons per day, tankless water heaters are 24%-34% more efficient than storage tank heaters [1]. Using twice the amount of water will lessen the efficiency improvements to 8%-14% [1]. The limit on the rate at which heat can be delivered can be mitigated by using multiple tankless water heaters throughout the building. Another indirect benefit of a tankless system is that it takes up less space than a tank system. Downsides to the tankless water heaters (electric versions) is that they will not provide hot water if there is a power outage [2], carry a higher initial investment compared to a traditional storage tank heater, require proper maintenance to avoid mineral buildup [2] and achieve a 20 year lifespan. Despite these drawbacks, tankless water heaters still have economic benefits due to reduced energy use and longer lifespan than a storage tank system (20 years vs. 15 years) [1,2].

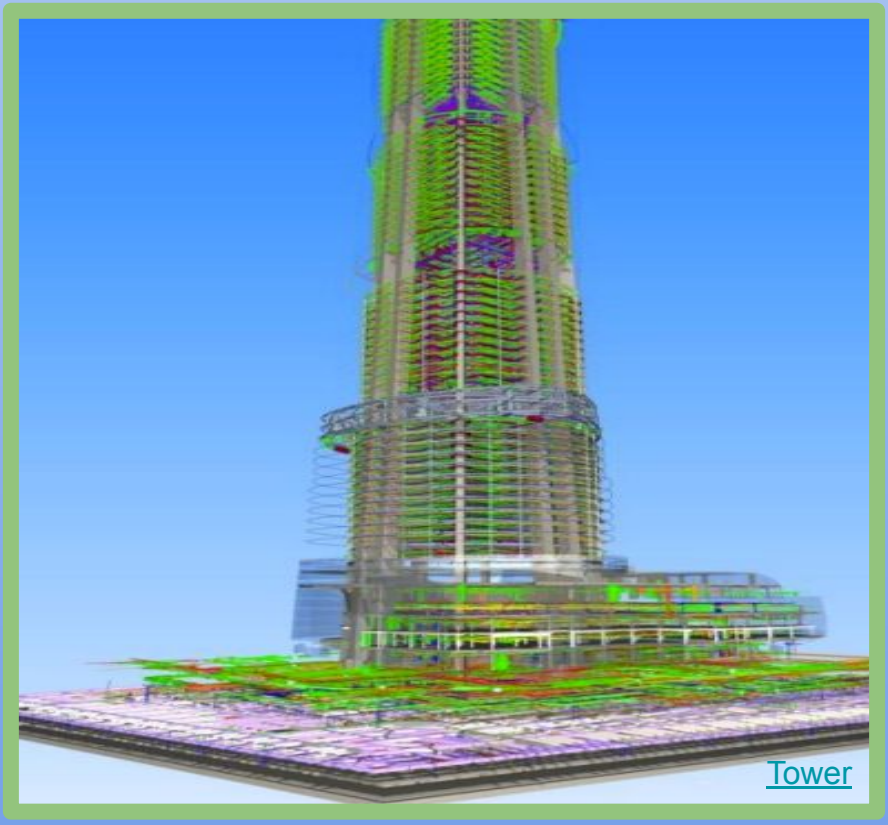
In conclusion, tankless water heaters provide the best option for homeowners and commercial properties going forward. Their ability to last longer, be more energy efficient, and save money provide little reason for homeowners to stick with their original systems. With the push for energy savings, starting with replacing your home's storage tank heater can be the first step in the right direction.

BIM Implementation in Shanghai Tower

By: Adetomiwa Awogbamila & Steven Castlegrant

The design, construction, and operation/maintenance of buildings and many other structures have become more complex throughout the course of time. These feats of modern engineering require a lot of close coordination between architects, engineers, and contractors. These projects are completed more effectively and efficiently through the use of Building Information (BIM) technology. In addition, the power of BIM is used to update and optimize existing structures. New Jersey Department of Military and Veterans Affairs (NJDMAVA) owns and operates multiple armories, offices, and other facilities across the state; many of which were built in the 1900s. The Sustainable Facilities Clinic (SFC) in Henry M. Rowan College of Engineering of Rowan University uses BIM in order to anticipate and reduce the cost of future renovations and repairs. One of the latest large-scale and immensely difficult modern architectural, engineering, and construction (AEC) projects that used BIM from start to finish is a skyscraper in China known as the Shanghai Tower.

The Shanghai Tower project started in 2009 and was completed and opened in 2015. It is located in the Pudong district of Shanghai. It contains 128 stories and stands at 632 meters (2073 feet) [1] in height making it the tallest in China and the second tallest in the world at the time of completion [2]. Shanghai Tower is a multi-functional skyscraper containing 9 cylindrical zones and 7 structural systems [2]. The lower levels consist of retail and market space while the mid to upper levels contain offices and hotels, and at the very top is the observatory. Its geometry consists of a smooth edge equilateral triangle for its horizontal profile which spirals vertically with a 120-degree twist. Over 30 consulting companies were hired along with a dozen more subcontracting companies throughout the duration of the project [2].



Shanghai Tower BIM model

'BIM..' continued on page 5

For the Shanghai tower, BIM was implemented during the initial phase of the project and was executed through to the end. The BIM application system uses several Autodesk programs including Revit Structure, Architecture, and Mechanical, Electrical, Plumbing (MEP) software [2]. Navisworks, a management and coordination software also aided in the completion of this project.

More effective communication, coordination, and data sharing were allowed since BIM technology was used throughout the design process of this project [2]. Shanghai Tower is one of many successful large-scale projects aided by BIM technology. Many of the software and methods used can greatly enhance the facilities management of NJDMAVA facilities by providing better, more efficient preventative maintenance and/or visibility. It could also accelerate the deconstruction and renovation phase of future projects. There is no telling the limitations of BIM in the future. As technology continues to rapidly advance, there is no telling the future of what BIM has in store.

Solar Heating vs Photovoltaic Systems: What's the Best Option for You?

By: Bryson Townsend and Trinity Good

In recent years, the use of renewable energy sources has become increasingly popular. According to the Solar Energy Industries Association, in 2022 "50% of all new electric capacity added to the grid came from solar" ("Solar Industries Research Data", 2023). Solar energy can be an accessible and affordable form of renewable energy, with two main options for buildings, including: solar heating and photovoltaic systems (PVs).

When most people think about solar energy, they think of the large panels found on buildings or out in a field that produce electricity. However, there are other types of solar systems that do not directly produce electricity, such as solar heating systems. Solar heating systems use the sun's energy to heat water, air, or other heat transferring fluids. The heated fluid is then sent throughout the building to supply heating or hot water (Cohen, 2023). These heaters can use either active or passive systems. Active solar water heating systems use pumps to circulate the water through a collector to heat water. Passive systems use direct sunlight to heat pipe collectors on a roof to heat the water which then flows into a storage tank to produce hot water. Active systems tend to be more efficient while passive tend to be more reliable and can last longer (Cohen, 2023). Both configurations can be beneficial for reducing the energy demand of heating buildings, providing hot water showers, and washing dishes.

Solar water heater collector on a rooftop.

'Solar heating..' continued on page 6

There are many advantages for solar heating instead of PV systems. Both systems can reduce energy bills and are more environmentally friendly compared to traditional heating systems. However, in comparing the two systems, solar heating can be "70% more efficient in collecting heat from sun rays than solar PV" (GreenMatch, 2023). As a result, they tend to use less space compared to PVs. Additionally, solar water heaters tend to cost less per amount of energy produced. Solar water heaters cost on average $0.05/kWh of thermal energy produced (Butler, 2008), compared to $0.105/kWh of electrical energy produced from a PV array (Carthan, 2023). Both of these costs can be reduced using state and federal incentive programs, such as Investment Tax Credit (ITC), which provides 30% of the installation cost beginning in 2022 (Murphy, 2023).

However, there are several advantages of PV systems instead of solar water heaters. While both require some maintenance to keep the solar collectors free of dirt, PV's require less maintenance because there are no moving parts. In solar water heaters, water in the pipes can freeze or boil, resulting in scaling damage in the pipes (McKay, 2022). Additionally, PVs do not waste surplus energy produced by net metering. In solar water heating systems, if the heated water is not used, it is lost through conduction of the storage tank (McKay, 2022).

In conclusion, both solar water heating systems and PV systems are environmentally friendly and can help reduce energy bills, making them a great way to save money and help the planet. Solar water heating systems are a good choice when the heating/hot water demand of a building is high. PV systems are a good choice when other electric demand is high. Before making a decision, it is important for the buyer to carefully consider their specific needs and circumstances and to seek the advice of a professional if necessary.

Benefits of Window Replacement

By: Nicholas Burd, Daniel Corrigan, & George Cullis

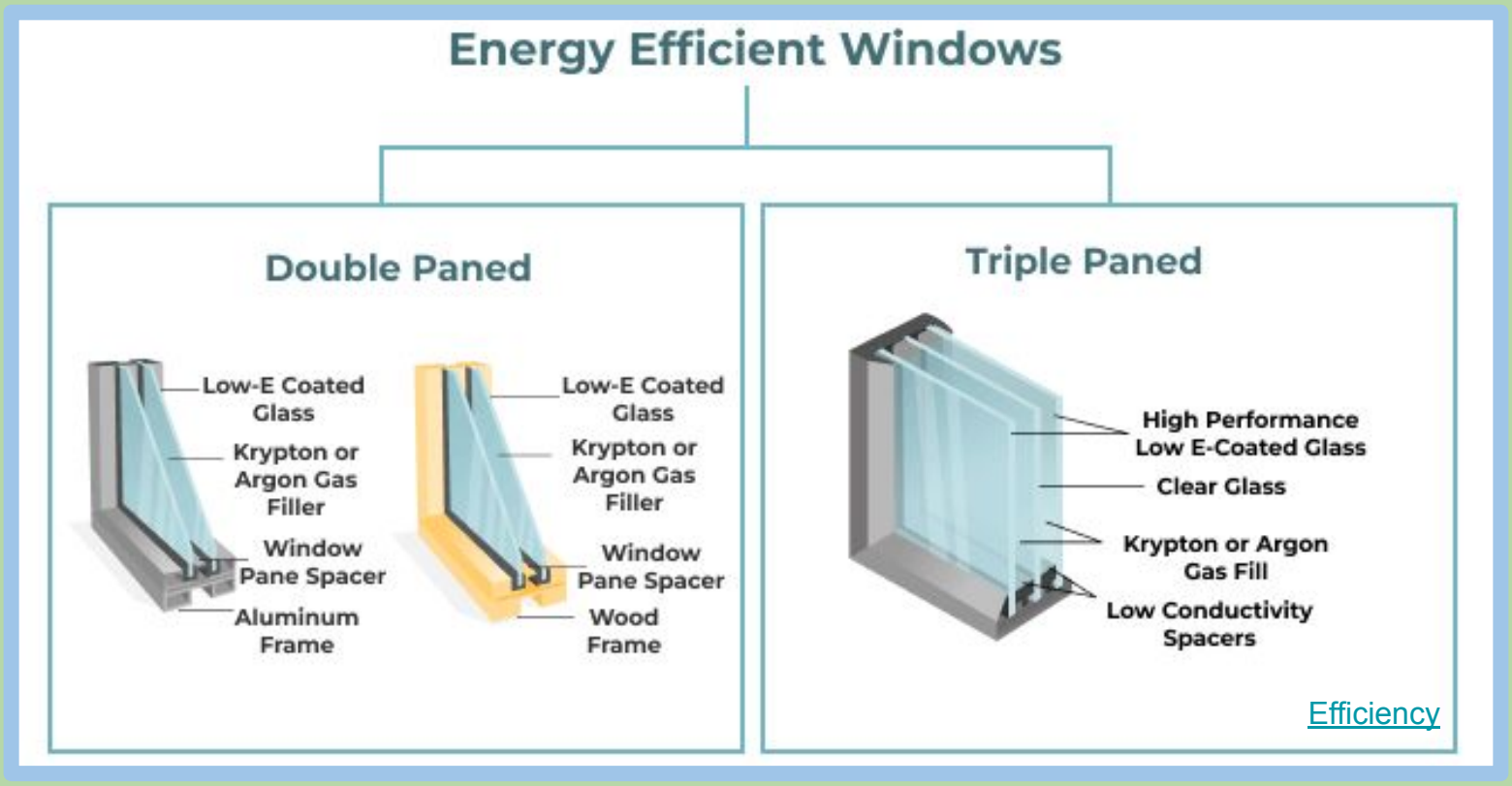
Windows are a great way to provide natural lighting to an office space. They reduce the need for electricity consuming light bulbs, they allow for natural heating, and they can improve the productivity of employees ("The Importance of…"). However, the type of window being used can have a big impact on energy bills. Approximately 30% of the heat energy in a building is lost by conduction through windows ("Energy Efficient Window Coverings"). Additionally, DoD mandates have been placed regarding the types of windows used in their facilities. Therefore, the right type of window needs to be selected.

Single vs. Double vs. Triple Panes

There are many types of windows available in today's market. Windows are typically classified based on the number of panes of glass they have. They can vary from single paned up to triple paned. Single pane windows are the cheapest to install, costing on average $100-$350, but provide the least thermal insulation (Carthan, 2023). These types of windows are typically found in older buildings. Another option that is typically recommended are double paned windows. Installation of double paned windows can cost up to three times the amount of single paned windows but can reduce energy usage for heating and cooling by 24%. ("The Benefits of…"). A third option is triple paned windows.These may provide a 30% savings in energy usage compared to double paned windows ("Single Vs. Double…") but can cost twice as much as double paned windows (Carthan, 2023).

'Replacement..' continued on Page 7

Triple paned windows are typically only recommended in extremely cold climates. They may also be recommended for noise insulation or improved security ("Single Vs. Double…"). The insulation of double and triple paned windows can be improved by choosing the gas insulator between the panes of glass. The most common gasses used are air, argon, and krypton. Argon and krypton are more dense than air which slows heat loss through the window ("Energy Efficient Window Costs").



Energy Efficient Window Visualization

Bulletproof windows

As of 12 Dec. 2018, the DoD mandates a specific level of antiterrorism protection afforded to its facilities. Per UFC 4-010-01, when windows are replaced or new windows are installed in DoD facilities, they will be no less than a ¼ inch thick layer of polycarbonate or laminated glass (Department of Defense [DoD], 2018). Polycarbonate windows of this thickness have a thermal efficiency between single and double paned glass windows. However, installing polycarbonate windows beyond the required DoD minimum would improve this ("How Thick Should…"), while affording an added measure of protection from forced entries as well as projectiles. The new windows being placed in New Jersey DoD facilities find themself being able to withstand explosives in the immediate perimeter of the facility with minimal damage and injury to occupants.

Windows play a crucial role in the efficiency and safety of a building. When installing windows it is important to look for those with better energy efficiency as this will drastically lower costs for both gas and electricity in the winter as well as summer. Additionally, the mandates for the DoD ensure that the windows of their facilities are resistant to attacks similar to ones we have seen in other countries.

Meet the Authors

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Facilities Management Clinic Team

Teresa is a Senior, majoring in Civil and Environmental Engineering. Teresa enjoys cooking, hiking, and reading and will pursue a career in project management.

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'Meet The Authors' continued on page 9

Meet the Authors

Save Space and Energy with Tankless Water Heaters

Ground Source Heat Pumps Clinic Team

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Andrew is majoring in Civil Engineering as a Junior. He enjoys working out and being outside with nature. His goal to work for himself someday.

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