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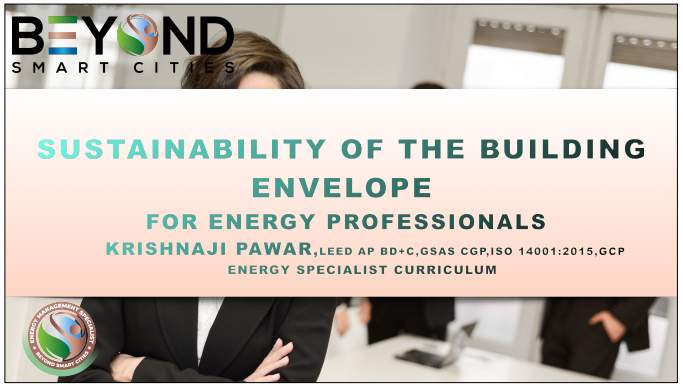
BEYOND
SMART CITIES
SUSTAINABILITY OF THE BUILDING ENVELOPE
FOR ENERGY PROFESSIONALS
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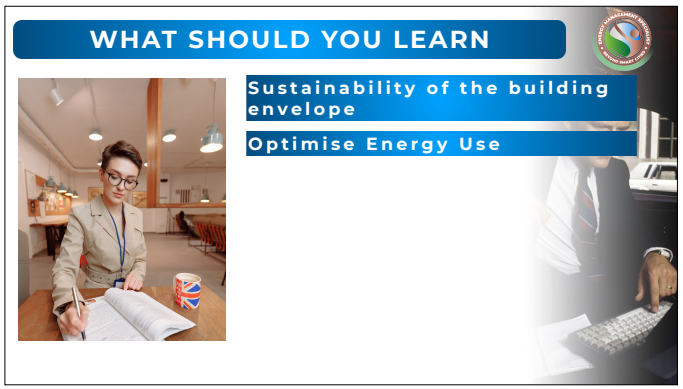

WHAT SHOULD YOU LEARN
Sustainability of the building envelope
Optimise Energy Use

INTRODUCTION

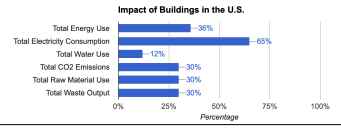
Since the early 1990s, sustainability has become an increasing priority for facilities projects. It is no secret that building construction and operation have an enormous direct and indirect impact on the environment in terms of energy use, atmospheric emissions, use of raw materials, waste generation, water use, and many other factors.

As the economy and population continue to expand, the design, construction and operation community will face increasing challenges to meet the new demands for facilities that are accessible, secure, healthy, and productive while minimizing their impact on the environment.

For the design, construction and operation of a facility, there is an especially important interface between the indoor and outdoor environments, that of the building envelope. The building envelope is comprised of the outer elements of a building—foundations, walls, roof, windows, doors and floors.

INTRODUCTION +

The prime functions of the building envelope are to provide shelter, security, solar and thermal control, moisture control, indoor air quality control, access to daylight, and views to outside, fire resistance, acoustics, cost effectiveness and aesthetics. Because of the varied and sometimes competing functions associated with the building envelope, an integrated, synergistic approach considering all phases of the facility life cycle is warranted. This "sustainable" approach supports an increased commitment to environmental stewardship and conservation, and results in an optimal balance of cost, environmental, societal, and human benefits while meeting the mission and function of the intended facility.



SUSTAINABILITY OF THE BUILDING ENVELOPE

The main objectives of sustainable design are to avoid resource depletion of energy, water, and raw materials; prevent environmental degradation caused by facilities and their infrastructure throughout their life cycle; and create built environments that are accessible, secure, healthy, and productive.

While the definition of what constitutes sustainable building design, construction and operation is constantly evolving, there are six fundamental principles that nearly everyone agrees on.

- Optimize Site Potential—Creating sustainable buildings starts with proper site selection, and the location, orientation, and landscaping of a building affect the local ecosystems, transportation methods and energy use. It is usually more sustainable to renovate an existing building than to tear it down and construct a new one. Consider reuse and retrofit of available existing buildings before deciding to build new.

SUSTAINABILITY OF THE BUILDING ENVELOPE +

- Optimize Site Potential—Creating sustainable buildings starts with proper site selection, and the location, orientation, and landscaping of a building affect the local ecosystems, transportation methods and energy use. It is usually more sustainable to renovate an existing building than to tear it down and construct a new one. Consider reuse and retrofit of available existing buildings before deciding to build new.
- Optimize Energy Use—A sustainable building should rely on efficiency and passive design measures rather than fossil fuels for its operation. It should meet or exceed applicable energy performance standards.
- Protect and Conserve Water—In many parts of the country, fresh water is becoming an increasingly scarce resource. A sustainable building seeks to reduce, control, and/or treat site runoff, use water efficiently, and reuse or recycle water for on-site use when feasible.

SUSTAINABILITY OF THE BUILDING ENVELOPE +

- Use Greener Materials—A sustainable building should be constructed of materials that minimize life-cycle environmental impacts such as global warming, resource depletion, and human toxicity. Life-cycle raw materials acquisition, product manufacturing, packaging, transportation, installation, use, and reuse/recycling/ disposal should all be taken into account.
- Enhance Indoor Environmental Quality (IEQ)—The indoor environmental quality of a building has a significant impact on occupant health, comfort, and productivity. Among other attributes a sustainable building should maximize daylighting, provide appropriate ventilation and moisture control, and avoid the use of materials that are high in VOC emissions.

SUSTAINABILITY OF THE BUILDING ENVELOPE +

- Optimize Operational and Maintenance Practices—Incorporating operations and maintenance considerations into the design of a facility will greatly contribute to improved work environments, higher productivity, and reduced energy and resource costs. Designers are encouraged to specify materials and systems that simplify and reduce maintenance requirements; require less water, energy, and toxic chemicals and cleaners to maintain; and are cost-effective and reduce life-cycle costs.

SUSTAINABILITY RECOMMENDATIONS

OPTIMIZE SITE POTENTIAL

- ☑ **Consider Climatic Conditions**—consideration of the local climatic conditions (temperature, moisture, wind) can influence the materials of construction of the building envelope, the amount of and performance of glazing used specific to each orientation, and the overall energy performance of the building.
- ☑ **Reduce Urban Heat Islands**—the design of the horizontal elements (roof) of the building envelope should consider the impact on the site's urban heat island. Finish the facility's roof with light colored finish materials or vegetated components to reduce energy loads and extend the life of the roof, especially in warmer climates. Consider incorporating vegetated roof materials. Use a roofing product that meets or exceeds Energy Star Standards.

SUSTAINABILITY RECOMMENDATIONS

OPTIMIZE ENERGY USE

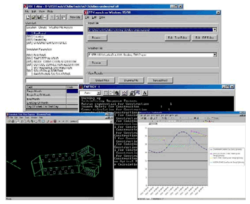
- ☑ **Optimize Thermal Insulation**—optimize the insulation performance of the envelope opaque elements for both heating and cooling seasons.
- ☑ **Incorporate High Performance, Spectrally Selective Glazing**—the orientation, amount and performance of vertical and horizontal glazing should be appropriate for the climate of the building. Carefully analyze the thermal (U-factor), solar (solar heat gain factor–SHGF) and daylighting (visible transmittance–VT) performance of glazing on each elevation of the building. The performance criteria will vary depending upon orientation and dominant strategy (e.g. solar performance or daylighting performance).

OPTIMIZE ENERGY USE

- ☑ **Employ Effective Solar Shading Devices**—use exterior shading devices such as overhangs, vertical fins and light shelves as energy efficiency measures (with consideration of maintenance and security/safety issues).
- ☑ **Consider using lighting sensors to control perimeter lighting levels when adequate daylight is available to reduce power and HVAC loads, particularly at peak demand periods which often coincides with times for high daylight availability.**
- ☑ **Integrate Photovoltaic Panels**—incorporate Building Integrated Photovoltaic (BIPV) panels as part of the building envelope system or solar shading system as a way of generating on-site, renewable energy.

OPTIMIZE ENERGY USE

- Analyze Envelope Performance with Energy Simulation—use energy simulation and life-cycle analysis tools to optimize the performance of all components of the building envelope. Make informed decisions about the components of the building envelope based on life-cycle performance



OPTIMIZE ENERGY USE

- Commission Envelope Elements—the building commissioning process should include commissioning of the building envelope to insure that all performance requirements are being met. Commissioning of the building envelope can identify areas of concern related to air infiltration and leakage, moisture diffusion, surface condensation, and rain water entry—all issues that can negatively impact the building's energy performance and indoor environmental quality. Of particular importance is to begin commissioning of the building envelope during design when design modifications can be easily incorporated, rather than waiting until construction when remediation can cost significantly more.

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