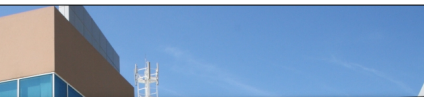


BUILDING ENVELOPE CEM REFRESHER
ONLINE TRAINING COURSE

KRISHNAJI PAWAR, LEED AP BD+C, GSAS CGP, ISO 14001:2015, GCP
ENERGY SPECIALIST CURRICULUM





HVAC INTEGRATION OF THE BUILDING ENVELOPE
FOR ENERGY PROFESSIONALS

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WHAT SHOULD YOU LEARN



HVAC Integration Of The Building Envelope

INTRODUCTION

Heating, ventilating, and air-conditioning (HVAC) systems account for nearly 40% of the energy used in commercial buildings in the United States. Consequently, almost any business or government agency has the potential to realize significant savings by improving its control of HVAC operations and improving the efficiency of the system it uses. There are also considerable opportunities for significant energy savings through efficient, integrated design, especially at the building envelope.

An integrated and efficient building envelope with appropriate window and glazing design can not only reduce the energy and operating costs of a facility, but can also reduce the size and cost of the HVAC system needed to maintain adequate building pressurization, good indoor air quality and a comfortable thermal environment for building occupants



DESCRIPTION

The term HVAC refers to the three disciplines of Heating, Ventilating, and Air-Conditioning. A fourth discipline, Controls, pervades the entire HVAC field. Controls determine how HVAC systems operate to meet the design goals of comfort, safety, and cost-effective operation.

✓ Heating can be accomplished by heating the air within a space (e.g. supply air systems, perimeter fin-tube "radiators"), or by heating the occupants directly by radiation (e.g. floor/ceiling/wall radiation or radiant panels).

✓ Ventilating maintains an adequate mixture of gases in the air we breath (e.g. not too much CO₂), controls odors, and removes contaminants from occupied spaces. "Clean" air helps keep occupants healthy and productive. Ventilation can be accomplished passively through natural ventilation, or actively through mechanical distribution systems powered by fans.



DESCRIPTION +

✓ Air-conditioning refers to the sensible and latent cooling of air. Sensible cooling involves the control of air temperature while latent cooling involves the control of air humidity. Room air is cooled by transferring heat between spaces, such as with a water loop heat pump system, or by rejecting it to the outside air via air-cooled or water-cooled equipment. Heat can also be rejected to the ground using geothermal exchange.

✓ Cool air is not comfortable if it is too humid. Air is dehumidified by condensing its moisture on a cold surface (such as a cooling coil), or by removing the moisture through absorption (desiccant dehumidification). In dry climates, humidification may be required for comfort instead of dehumidification. Evaporative humidification also cools the air. Radiant cooling systems and mixed mode cooling applications are being used where appropriate.



DESCRIPTION +

✓Controls ensure occupant comfort, provide safe operation of the equipment, and in a modern HVAC control system enable judicious use of energy resources. HVAC systems are sized to meet heating and cooling loads that historically occur only 0.4% to 2.5% of the time. It is the function of the controls to ensure that the HVAC systems perform properly, reliably, and efficiently during all of the conditions that occur 97.5% to 99.6% of the time.

There is a critical interface at the perimeter of all buildings between the building envelope and the building's HVAC and control systems. Following are several significant issues that should be addressed when optimizing this interface:

- ✓Integrated, Whole Building Design
- ✓Minimize Energy Consumption at the Building Envelope
- ✓Providing Comfortable Environments in Perimeter Areas
- ✓Achieve Appropriate Indoor Air Quality and Building Pressurization
- ✓Employ Measures for Safety and Security
- ✓Consider Rooftop Equipment



INTEGRATED, WHOLE BUILDING DESIGN

✓Use an Integrated, Whole Building Design approach for the building envelope with appropriate consideration given to optimized levels of thermal insulation; the size, location and performance of windows and glazing systems; appropriate external shading and solar control; thermal comfort; moisture control; acoustic privacy; daylighting and control; and security/safety considerations. Each of these individual parameters can impact the effectiveness of the building's HVAC system.



MINIMIZE ENERGY CONSUMPTION AT THE BUILDING ENVELOPE

✓Consider Climate Conditions—building envelope components should be responsive and appropriate for the climate of the building. This can result in a smaller and more efficient HVAC system.

✓Optimize Thermal Insulation—optimize the insulation performance of the envelope opaque elements for both heating and cooling seasons. This can result in a smaller and more efficient HVAC system.

✓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). This can result in a smaller and more efficient HVAC system.



MINIMIZE ENERGY CONSUMPTION AT THE BUILDING ENVELOPE

✓ **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). This can result in a smaller and more efficient HVAC system.

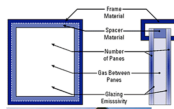


Figure 1. Factors Affecting Window Performance

✓ **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.

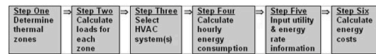


Figure 3. Flow Chart to Determine Energy Costs

MINIMIZE ENERGY CONSUMPTION AT THE BUILDING ENVELOPE

✓ **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.

MINIMIZE ENERGY CONSUMPTION AT THE BUILDING ENVELOPE

✓ **While the LEED® Green Building Rating System** requires buildings to undergo Fundamental Building Commissioning of systems to achieve certification, it merely recommends that some form of building envelope commissioning be incorporated. Beyond Smart Cities have proposed a Building Envelope Commissioning process that could supplement the Fundamental Building Commissioning required for LEED® certification.

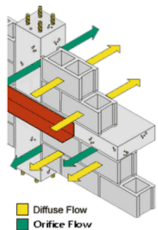


Figure 4. Air Leakage through a Building Enclosure