



ENERGY SIMULATION OF HIGH PERFORMANCE GREEN BUILDINGS

FOR ENERGY AND GREEN BUILDING SPECIALISTS

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ENERGY SPECIALIST CURRICULUM

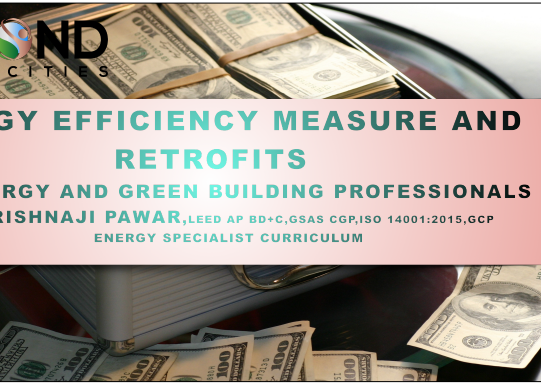




ENERGY EFFICIENCY MEASURE AND RETROFITS

FOR ENERGY AND GREEN BUILDING PROFESSIONALS

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LEARNING OBJECTIVES



- Energy Efficiency Measures definition
- General Efficiency Measures
- Chillers Specific Measure
- AHU Specific Measure
- Insulation Specific Measure
- Control Use of Sun Light



WHAT IS ENERGY EFFICIENCY MEASURES?

Energy Efficiency Measures means an element of design that minimizes energy consumption and integrates passive and active design elements while meeting the operational needs of the facility.

Energy efficiency measures for buildings are approaches through which the energy consumption of a building can be reduced while maintaining or improving the level of comfort in the building.

General Efficiency Measures , Chillers Specific Measures ,AHU Specific Measures ,Boiler Specific Measures Room Air Conditioning Measures Building Air Leakage Measures ,Building Insulation Measures ,Control Use of Sun Light ,Electric Lighting Measures Independent Energy Using Equipment Transformer Specific Measures Service Water System Measures



GENERAL EFFICIENCY MEASURE

- ✓Night Pre-cooling
- ✓Air-to-Air Heat Recovery—Heat Exchange Enthalpy Wheels
- ✓Air-to-Air Heat Recovery—Heat Pipe Systems
- ✓Air-to-Air Heat Recovery—Run-Around Systems
- ✓Displacement Ventilation
- ✓Dedicated Outdoor Air Systems
- ✓Ventilation Demand Control Using CO₂
- ✓Hybrid Ventilation
- ✓Variable Flow/Variable Speed Pumping Systems
- ✓Low-NO_x Burners



GENERAL EFFICIENCY MEASURE +

- ✓Combustion Air Preheating
- ✓Combination Space/Water Heaters
- ✓Ground-Source Heat Pumps
- ✓Water-Loop Heat Pump Systems
- ✓Thermal Energy Storage for Cooling
- ✓Double-Effect Absorption Chillers
- ✓Gas-Engine-Driven Chillers
- ✓Gas-Fired Chiller/Heaters
- ✓Desiccant Cooling and Dehumidification
- ✓Indirect Evaporative Cooling
- ✓Solar Energy System—Photovoltaic



GENERAL EFFICIENCY MEASURE +

- ✓Light Conveyor
- ✓Water-Conserving Plumbing Fixtures
- ✓Gray-water Systems
- ✓Point-of-Use Domestic Hot Water Heaters
- ✓Direct-Contact Water Heaters
- ✓Rainwater Harvesting
- ✓Mixed Air Temperature Reset
- ✓Cold Deck Temperature Reset with Humidity Override



CHILLERS SPECIFIC MEASURE

Equipment Scheduling And Operating Practices

- Distribute the cooling load among chillers in the manner that minimizes total plant operating cost. 1 - 20 % of cost of chiller operation.
- Use automatic controls to shut down the entire chiller plant when there is no cooling load.
- Turn off and isolate heat rejection equipment when the corresponding chiller turns off. 5 - 30 percent of the energy used by the condenser water pumps and cooling unit fans.
- Install power switching that prevents unnecessary operation of spare pumps.
- Turn off compressor sump/crankcase heaters during extended shutdown intervals. 20 - 200 dollars per year per compressor.



CHILLERS SPECIFIC MEASURE +

Optimum Operating Temperatures

- Keep the chilled water supply temperature as high as possible.
- Optimize the condensing temperature.

Heat Rejection Equipment

- Sequence the fans efficiently in multiple-cell cooling units. 10 - 40 % of fan energy and 1 - 5 % of chiller energy.
- Clean heat rejection units at appropriate intervals. 0.1 - 5 % of chiller system operating cost.
- Keep heat rejection unit housing and fittings intact. 0.1 - 2 % of chiller system operating cost
- Avoid recirculation of air through the same or adjacent heat rejection units. 5 - 30 % of the fan energy of the heat rejection unit and 0.1 - 2 % of chiller energy consumption.
- Pump Energy Consumption, Adjust the discharge of pumps to match system flow and/or pressure requirements.
- Refrigerant Condition, Repair chiller system leaks, Maintain the proper refrigerant charge, Install accessories that prevent air leakage into idle chillers by pressurizing them to keep the internal pressure higher than atmospheric.



CHILLERS SPECIFIC MEASURE +



System Design for Efficient Low-Load Cooling

- Install local cooling units to allow shutting down the central chiller plant during periods of low load. 5 - 30 % of total cooling energy consumption
- Provide cross connections that allow shutting down the least efficient chillers if a facility has several chiller plants. 5 - 20 % of total chiller plant energy consumption

Heat Recovery From Chillers

- Install a heat recovery chiller to recover large amounts of heat at elevated condensing temperatures.
- Install a de-superheater to recover small quantities of heat at maximum temperature. The amount depends on the refrigerant and the features of the compressor.

Cooling Thermal Storage

- Install cooling thermal storage. Varies widely



AHU SPECIFIC MEASURE +



Minimize Duration of Operation

- Turn off air handling systems when they are not needed.
- By using time clocks to start and stop air handling equipment where spaces operate on regular schedules. 10 - 70 % of the air handling system's operating cost.
- By installing optimum start controllers to adapt starting times to weather conditions. 1 - 10 % of the air handling system's operating cost.

Outside air intake and building pressurization.

- Adjust outside air intake to the minimum needed to satisfy comfort, health, and code requirements, and to maintain proper building pressurization. The savings are sure, greatest in climates that have extremes of temperature or humidity. By controlling outside air intake By sensing air contaminants. 30 - 70 % of the cost of conditioning outside air.
- Use air cleaning to reduce the need for outside air ventilation.
- Install a purge cycle for overnight cooling. 0.1 - 2 % of cooling energy
- Improve the envelope penetrations of air handling systems to minimize air quality problems, wind problems and energy requirements. Varies widely.
- Minimize the use of extra heat for freeze protection 0.5 - 5 % of conditioning energy
- Eliminate air handling system stratification that increases energy consumption or reduces comfort. Varies widely.



BUILDING SPECIFIC MEASURE +



Personnel Doors

- Maintain the fit, closure, and the sealing of exterior doors. 10 - 200 dollars per year per door depending on climate , energy cost, space layout etc.
- Install appropriate weather stripping on exterior doors. 10 - 200 dollars per year per door depending on climate , energy cost, space layout etc.
- Install a revolving door if a pressure differential at the entrance is unavoidable. Thousands of dollar per year where a high pressure differential exists at the entrance.
- Install vestibules for doors with frequent traffic. 100 - 1000 dollars per year per door depending on climate , energy cost, building orientation etc.

Window Air Leakage

- Maintain the fit, closure and the sealing of windows. Upto 50 % of heating and cooling costs.
- Install weather stripping on open able windows. 3 - 60 % of heating and cooling costs, depending on the type and size of windows, space layouts etc.



BUILDING SPECIFIC MEASURE +

Other envelope Leakage

- Seal gaps in the envelope structure. Varies widely
- Install gaskets at wall switches and receptacles that allow outside air leakage. Typically about one dollar per year per gasket.
- Install roof and attic hatches that close tightly and reliably. 100 - 1000 dollars per year in heating costs.
- Adjust and repair space air vents periodically. 100 - 1000 dollars per year in heating costs. Ventilate elevator shafts rationally. Several hundred dollars per year per elevator



INSULATION SPECIFIC MEASURE +

Roofs and Attics

- Increase the quantity of attic insulation. Reduces heat loss by 70 - 90 %
- A rigid insulation to the top surface of the roofs. Reduces heat loss by 70 - 90 %
- Apply sprayed foam insulation to the top surface of roofs. Reduces heat loss by 70 - 90 %
- Install insulation on the underside of roofs. Reduces heat loss by 70 - 90 %
- Install a suspended insulated ceiling. Reduces heat loss by 60 - 80 %

Walls and Soffits

- Insulate wall cavities. 40 - 70 % of the heat loss and heat gains through the insulated portions of the wall.
- Insulate the inside surface of the walls. 60 - 95 % of the heat loss or heat gain through the wall.
- Insulate the outside surface of the walls. 60 - 90 % of the heat loss or heat gain through the wall.
- Increase the thermal resistance of the panels in curtain walls. 60 - 90 % of the heat loss or heat gain through the wall.



INSULATION SPECIFIC MEASURE +

Glazing Insulation

- Install storm windows or supplemental glazing. About 35 - 65 % of conductive heat loss depending upon the number of original panes and the number of supplemental panes.
- Reduce the area of glazing.
- Install thermal shutters. 60 - 80 % of heat loss through the affected glazing.
- Use window films that reflect heat back into the building.



CONTROL USE OF SUN LIGHT

Reducing Cooling Load: Windows & Skylights

- Install external shading devices. Save 70 - 95 % of the cooling load caused by the shaded glazing.
- Install internal shading devices. 20 - 50 % of the cooling load caused by the shaded glazing.
- Install solar control films on existing glazing. 35 - 60 % of the solar cooling load
- Reduce the area of glazing. Up to 50 % of total Heating cooling costs

Reducing Cooling Load: Opaque Surface and Overall.

- Improve the insulation of surfaces exposed to sunlight.
- Apply paint, coating or sheathing that minimizes absorption of sun light. Save up to 30 - 70 % compared to using a finish with high heat gain.
- Effective ventilation of attics. 30 - 70 % of the cooling load through the attic.

CONTROL USE OF SUN LIGHT

Day lighting

- Install skylights or light pipes. Skylights increase heating and cooling cost but this penalty should be minor if the skylights are sized and laid out properly.
- Install diffusers for existing clear skylights. 30 - 80 % of lighting costs.
- Install translucent roof and wall sections for day lighting. Install a system of light shelves and shading. 10 - 40 watts per foot along the wall.

Passive Solar Heating

- Keep open the window shades of unoccupied spaces that need heating. 20 - 80 % of heating costs in the sun lighted spaces.
- Install combinations of sunlight absorbers and reflectors inside windows and skylights. 10 - 100 % of heating costs in the sun lighted spaces.

BEYOND
SMART CITIES

THANK YOU

THE WORLD'S 1ST GREEN TECHNOLOGY
MARKETPLACE
