

# Using HVAC Controls to Optimize System Efficiency

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# “Building” vs. “HVAC” Optimization

## Typical “Building” Optimization Strategies:

- Building Envelope
  - New Windows
  - More Insulation
- BAS/DDC Control System
  - Optimum Start/Stop
  - Time of Day Control
  - Optimum Stop
  - Night Setback
- Lighting Re-Lamping

# “Building” vs. “HVAC” Optimization

## Typical “HVAC” Optimization Strategies:

### – “Downsize” Heating & Cooling Equipment

- Control runtime based upon actual building “load”
- Use latent heat and cooling in system
- Delay cycle start times of burners & compressors

### – Result:

- substantial reduction in fuel & power
- No effect on comfort

# “HVAC” Optimization-*General*

- Consider these facts:
  - A heating or cooling system must be able to provide acceptable comfort at the lowest anticipated outdoor temperature. This worst-case scenario (Design Day) occurs only a small fraction of the time.
  - In the U.S. and abroad, most boilers have a heat capacity between 1.5 to 2 times larger than that needed to maintain the space temperature on these extreme days.

# “HVAC” Optimization-*General*

- Consider these facts (con’t):
  - At all other times this design consideration renders the system relatively over-sized for the demand, which causes the system to run, or cycle, in less than an optimum manner.

# “HVAC” Optimization-*Heating*

## Heating System facts:

- Due to over-sizing of the boiler, the burner cycles on and off continuously - off to prevent overheating of the system water during any call for heat.
- The Burner cycling rate is directly proportional to the Heating load and System losses.
- There is substantial energy stored in the heating medium (water / steam) that can be extracted and used during a “hold-off” period (delay the on-cycle) without any substantial loss of output.
- This is due to the fact that not only can the boiler generate heat faster than it can be extracted, it also generates more heat than what can be extracted. Those two facts are why the burner cycles and why the space temperature doesn't change.

# “HVAC” Optimization-*Heating*

How optimization can be accomplished:

- In the case of a heating system, the load, or demand, needs to be analyzed by monitoring the out-flow water temperature or steam pressure.
- The absolute value of the water temperature or steam pressure, and the rate that it's changing, is indicative of the building's load.
- An heating system algorithm is used to calculate the “hold off” period.

# “HVAC” Optimization-Cooling

## Cooling System facts:

- In the case of a cooling system, the rate and quantity of heat that a cooling system can remove during a given period of time, is greater than the amounts of heat that can be gained by the load (space) for the same period of time.
- This requires the compressor to be cycled in order to maintain the desired temperature or the space would be over-cooled.
- The media used to extract heat from the space is air. Air has a very low mass and thus short time-constant (change in temperature per unit of time) compared to items with considerably more mass and thus a longer time-constant (i.e. people, objects, walls, furniture, etc.)

# “HVAC” Optimization-Cooling

## Cooling System facts (con’t):

- The items with a higher mass have a much greater thermal inertia. Thermal inertia is a property of an item to resist a change in temperature [for a given period of time].
- Since the compressor is held off for only a small percentage of time, relative to the time-constants of the higher mass items temperature fluctuations are virtually non-existent.
- An cooling system algorithm is used to calculate the “hold off” period.

# Heating System Optimization: *BENEFITS*

- Reduces Fuel Consumption 10 to 20%.
- Short Payback Period - Typically 6 to 18 Months
- Extends Boiler Life by Reducing Burner Cycling 30% or more.
- Reduces Burner Emissions Dramatically by Reducing the Number of Burner Starts.
- Reduced System Maintenance.

# Cooling System Optimization: *BENEFITS*

- Reduces Compressor Electric Consumption 10 to 20%.
- Short Payback Period - Typically 6 to 12 Months.
- Longer Compressor Life.
- Reduces System Maintenance Requirements.

# For further information, contact:

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