

Small/Medium-Sized Commercial Building Re-tuning Training

Collecting Building Information and Building Walk-Down

A PRESCRIPTIVE APPROACH TO RE-TUNING SMALL/ MEDIUM-SIZED COMMERCIAL BUILDINGS



Small/Medium-Sized Building Re-tuning Training: Collection of Basic Building Information

- ▶ This is the first step in the building re-tuning process
- ▶ Information collected in this step is used to plan the building walk-down or the **Investigation phase**
 - ▶ Size, age and type of building
 - ▶ As-built and construction documents
 - ▶ O&M Manuals, Sequence of Operations (SOP)
 - ▶ Types of equipment, recent repairs
 - ▶ Equipment maintenance schedules
 - ▶ Review logs (e.g. tenant complaints, etc.)
 - ▶ Construction or changes to the building
 - ▶ Building occupancy/equipment schedules
 - ▶ Use/mission of the building
 - ▶ Meter data (if available)



Small/Medium-Sized Building Re-tuning Training: Building Information Log Example

Building Name and Location	
Building prints and As-Built(s)	
Mission or Building type	
Types of HVAC equipment (Heat pump, gas w\DX cooling, etc.)	
HVAC equipment count	
Maintenance Schedules	
Age of the building	
Construction or renovations	
Complaint log data	
Building occupancy schedules	
Meter data or billing data	
Other	



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Building Walk-Down: Investigation Phase



Small/Medium-Sized Building Re-tuning Training: Building Walk-Down Focus Areas

- ▶ This is the second step in the building re-tuning process – the **Investigation phase**
- ▶ Information collected in this step is used to identify the operational problems and energy savings opportunities to plan implementation of re-tuning measures
 - ▶ Building Envelope
 - ▶ HVAC Systems and Controls
 - ▶ Lighting Systems and Controls
 - ▶ Hot Water
 - ▶ Office Equipment
 - ▶ Indoor Environmental Conditions
 - ▶ Air Distribution Systems
 - ▶ Meter Profile



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Small/Medium-Sized Building Re-tuning Training: Building Walk-Down Guidance

- ▶ While walking-down to investigate the building condition and operations, be vigilant, use your senses – look, listen, smell and touch (be careful!)
- ▶ If possible, perform the walk-down during both occupied hours and also during unoccupied hours (nights and weekends)
- ▶ A lot of energy waste typically occurs during unoccupied periods and holidays
- ▶ Walk-down should also be attempted at least once during the heating season and at least once during the cooling season.
- ▶ Log all information on the log sheets provided – these logs will be useful in the next phase – **Implementation phase!**

Small/Medium-Sized Building Re-tuning Training: Tools to Carry on Building Walk- Down



Building Envelope

WALKING-DOWN THE OUTSIDE OF THE BUILDING

Investigation: Door and Windows

**Broken or
loose
weather
stripping
allows air to
infiltrate into
the building**



Investigation: Door and Windows

Exterior door seals are missing



Investigation: Door and Windows

Loading dock door is open and interior double doors to building lack seals. Seal interior doors connected to loading docks or hallways adjoining exterior spaces.



Investigation: Door and Windows

Interior hallway doors to loading dock are not sealed. Seal doors connected to spaces that are exposed to outside conditions



Investigation: Door and Windows

Exterior window is cracked. The thermal barrier is now compromised



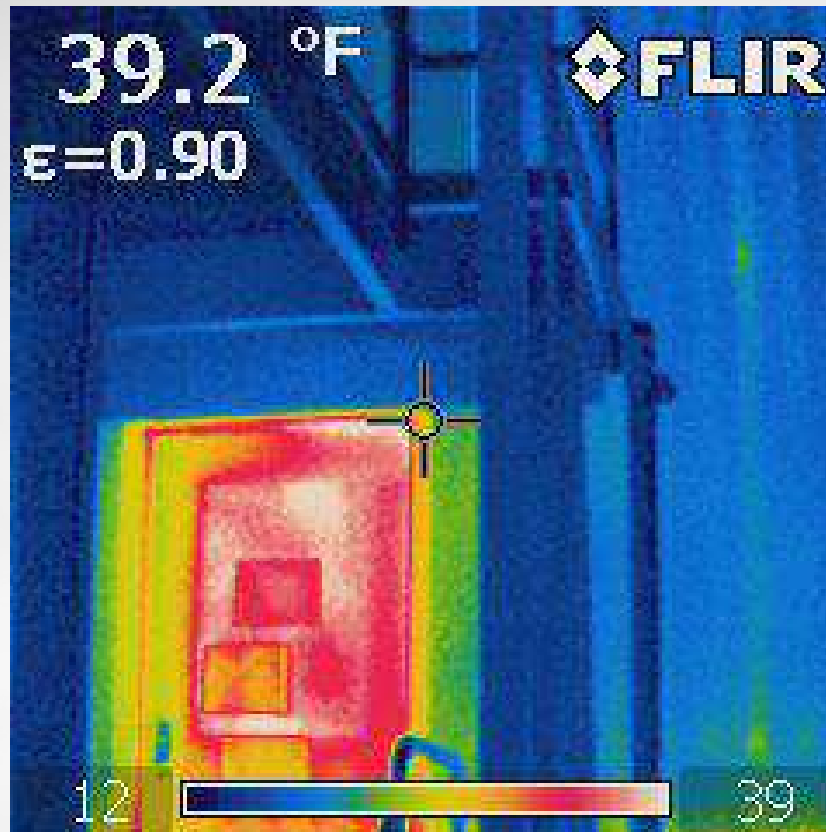
Investigation: Door and Windows

Un-insulated doors or rollup doors are a source of heat loss in the winter and heat gain in the summer



Investigation: Door and Windows

Un-insulated exterior door's thermal image take in the winter. Red indicates heat loss



Investigation: Exterior Awnings & Window Shades

Use sun shades, blinds or similar window treatments to reduce solar gain and glare. Lowered in the summer, raised in the winter.



Source:

<http://www.markiluxawnings.com/Markilux-760-860-Exterior-Commercial-Solar-Shade>

Dec. 11, 2012

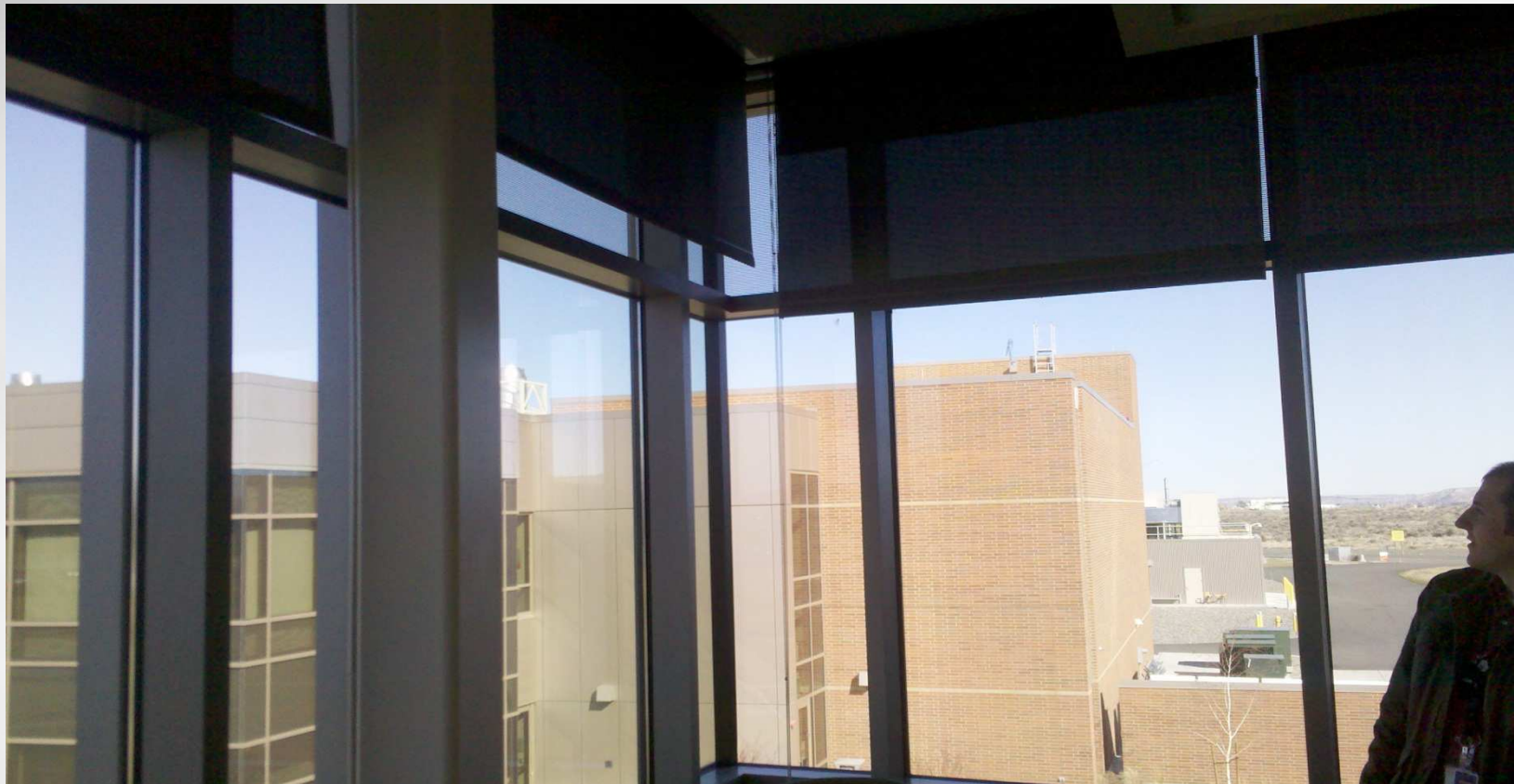
Investigation: Exterior Awnings & Window Shades

Use sun shades, blinds or similar window treatments to reduce solar gain and glare. Lowered in the summer, raised in the winter.



Investigation: Interior Window Shading Devices

Use sun shades, blinds or similar window treatments to reduce solar gain and glare (unless lighting controls use natural daylight)



Investigation: Interior Window Shading Devices

Use sun shades, blinds or similar window treatments to reduce solar gain and glare



Investigation: Roofs

Roof clean and no debris. Ensure white (cool) roofs are clean and free of debris



Source:

<http://www.daisygreenmagazine.co.uk/lifestyle-main/features-living/paint-the-town-white/>

Dec. 11, 2012

Investigation: Roof

Roof clean and no debris. Clean white roofs can help reduce heat gain and help air-cooled rooftop equipment operate more efficiently



Source:
<http://restoreroofs.blogspot.com/2011/04/how-cool-can-cool-be.html>
Dec. 11, 2012

Investigation: Building Exterior – Louvers and Grills

Exhaust grills in close proximity to intake grills can be problematic



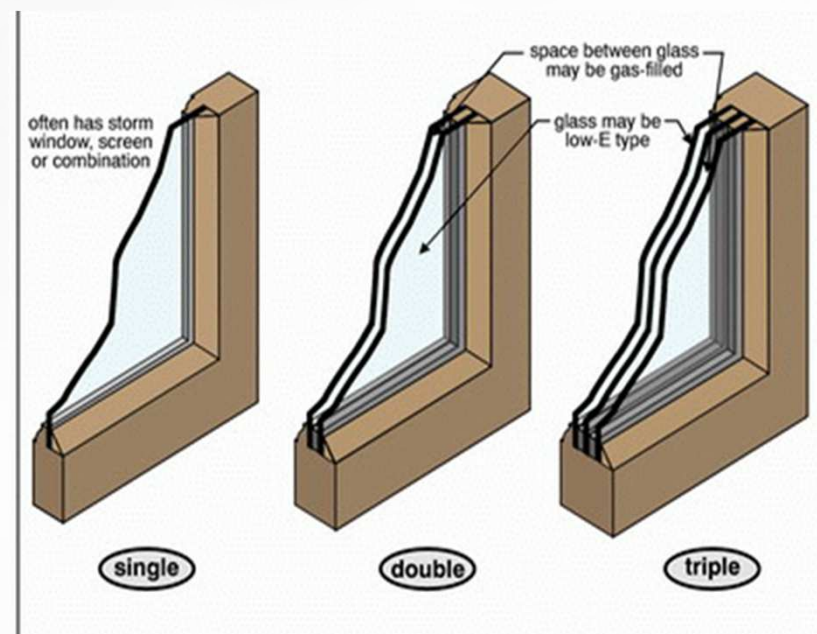
Building Envelope Walk-Down: Doors and Windows

- ▶ Focus on the outside conditions of the building
- ▶ Door and window type
 - Are the windows operable?
 - Are the windows single, double or triple pane?
 - Are any windows and outside doors open during the walk-down?
 - If windows and doors are open, this could indicate a problem related to heating, cooling or ventilation



Building Envelope Walk-Down: Windows

- Cost savings for upgrading windows will vary from location to location.
- Local utilities may offer incentives to upgrade.





Building Envelope Walk-Down: Discussion

Because windows are one of the least insulated parts of a building, double panes are usually considered the standard for a well-insulated building.

You can tell how many panes a window has by looking at where it connects with the frame. If there are no dividers, it's single pane, if there is one divider, it's double pane, and if there are two dividers, it's triple pane.

If there is condensation between the window panes, it usually means the integrity of the seal between the panes has been compromised (which usually means the insulating properties are also diminished).

The number refers to how many layers of glass each window has. The more layers of glass, the better insulated the window and the more it costs. In between each layer is an insulating gas. Double pane windows are about three times as well insulated as single pane windows, and triple pane windows are about four times as well insulated.

Typical cost savings for heating and cooling, when choosing ENERGY STAR rated windows is estimated to be \$146 (California) up to \$501 (New England) per year when replacing single-pane windows. Cost savings vary from region to region across the U.S. (http://www.energystar.gov/index.cfm?c=windows_doors.pr_benefits)



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Building Envelope Walk-Down: Door and Windows

- ▶ Door and window seals
 - Check seals around doors and windows – are there large air gaps?
 - Are the seals missing?
 - Look for cracks in the caulking for the windows, doors and seismic joints
 - Missing caulking?
 - Moisture between panes? Cracks in the panes?





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Building Envelope Walk-Down: Windows and Door Shades

- ▶ Operable shades, if used properly, can reduce cooling load in summer time (fully closed) and provide day lighting and solar heat gain during winter time (open)
- ▶ Check if shades are being used appropriately?
- ▶ If the windows are missing shades or not using shades, recommend adding shades and using them properly



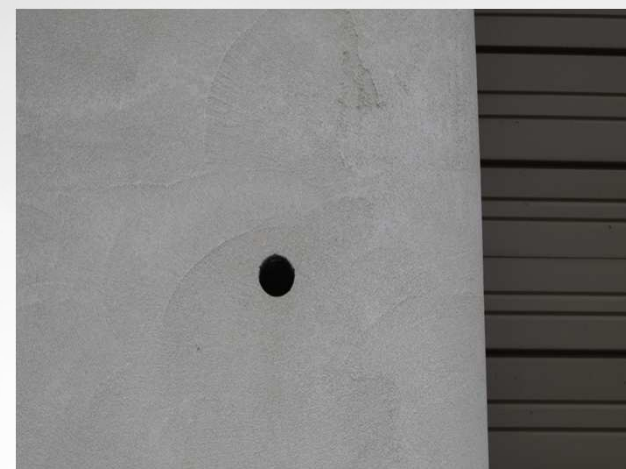


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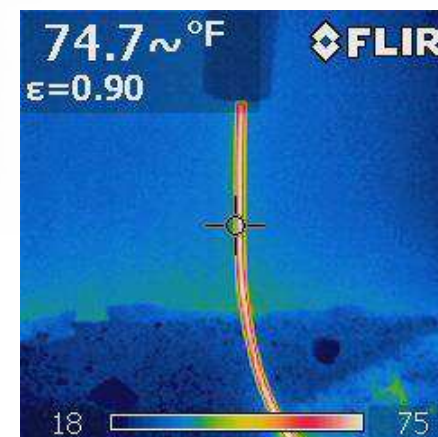
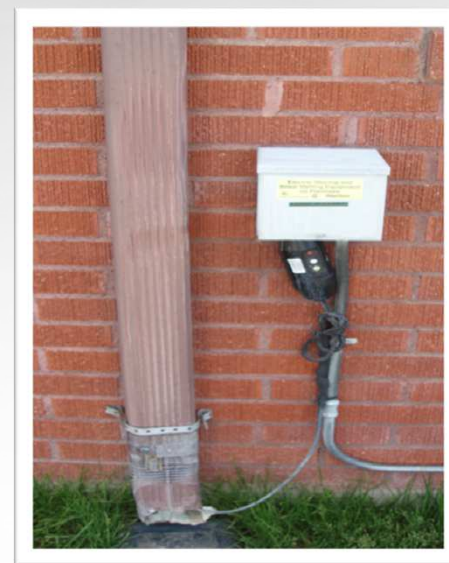
Building Envelope Walk-Down: Unsealed Penetrations in the Envelope

- ▶ Are there unsealed penetrations in the building?
 - Look for penetrations around seams or pipe penetrations in the building envelope
 - Improperly sealed holes will allow for increased infiltration into the building, which will lead to increased heating and cooling loads on the HVAC equipment
 - Have there been any problems or indication of vermin (mice or rats) entering the building? **This could be a health safety issue**



Building Envelope: Heat Traces and other exterior plug loads

- ▶ Some buildings may use heat traces on outside water lines, gutters, or storm drains to avoid freezing or ice/snow build up
 - Touch and feel for heat (be careful!)
 - If they are on during summer, spring or fall, recommend that they be turned off until needed





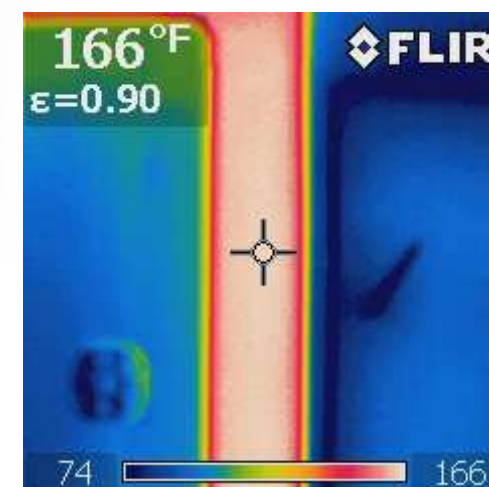
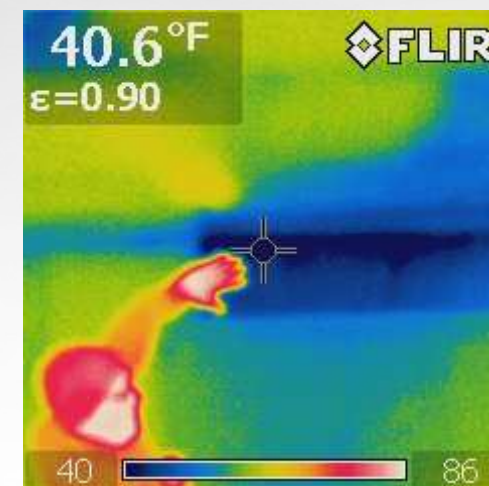
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Building Envelope Walk-Down: Insulation

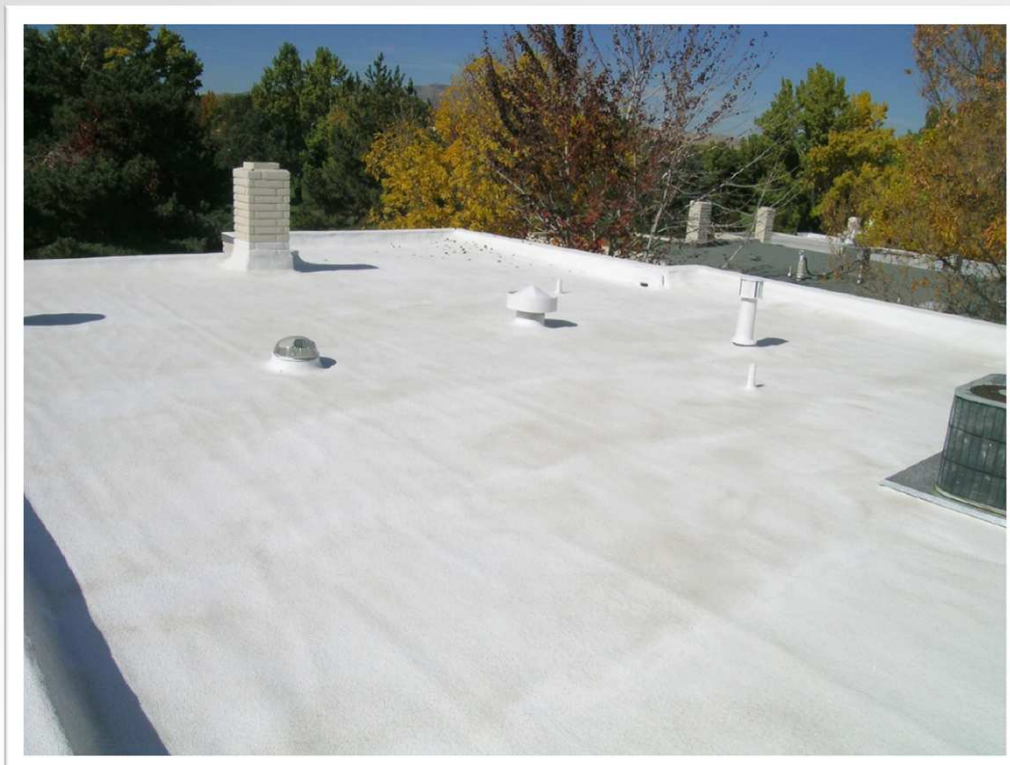
► Insulation

- Use a temperature gun (or infrared camera) and take temperature readings of the walls and the ceiling
- If the perimeter wall temperature of a perimeter office/space is significantly different from the other interior wall temperatures of the same space, the perimeter wall may not have adequate insulation or it has been compromised at strategic locations that should be further evaluated for potential improvements. A well insulated wall should show a large temperature difference between the outdoor and indoor temperature
- Look for missing insulation on any piping that carries heated or chilled water or steam
 - Missing insulation will contribute to energy costs and is a low cost fix



Building Envelope Walk-Down: Roofs

- ▶ Is the roof white?
 - Is it clean and no debris?
 - A white membrane roof needs to be clean; it has its best insulating properties when the roof is clean
 - As much as **3 degrees** of improvement in heat rejection versus a dirty roof.



Source:

<http://www.daisygreenmagazine.co.uk/lifestyle-main/features-living/paint-the-town-white/>

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Building Envelope: Attic and Crawl Spaces

- ▶ Ventilation of attic and crawl spaces
 - Look for crawl space vents and attic vents that are closed or plugged
- ▶ Look for powered exhaust in attics
 - Do they have backdraft dampers?
 - Check if the temperature controls for the fan are working
- ▶ Look for missing or damaged insulation in attic or crawl spaces
 - Damaged by water or animals?
 - Hanging loose from roof deck?
- ▶ Look for abandoned vents in lunchrooms (that were used to exhaust stove heat). These abandoned legacy vents can let outdoor air into the building if not properly sealed.



HVAC Systems and Controls

CONTINUING THE WALK-DOWN OF THE BUILDING



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Building Walk-Down: HVAC Systems and Controls

- ▶ Small/medium-sized buildings typically have packaged air conditioners with gas furnaces or heat pumps with either gas furnace or auxiliary electric strip heating
- ▶ Gas-Fired Equipment
 - Verify that the combustion-air intake is properly configured with no blockages
 - Verify that the gas pressure regulator is set correctly (trained technician)
- ▶ Packaged units are typically controlled by wall mounted thermostats with varying functionality
- ▶ Many of these units are not properly maintained



Building Walk-Down: HVAC Systems Inspection

- ▶ While walking-down, count how many units are serving the building
- ▶ Note the type of units
 - Split or packaged?
 - Air conditioners with gas furnace or heat pumps with auxiliary electric heating?
 - Tonnage of the units
- ▶ While examining the HVAC equipment, look for:
 - Missing panels/access doors or leaking panels/access doors
 - Outdoor-air dampers wide open or fully closed
 - Missing condenser fans
 - Poor maintenance (oil leakage at refrigerant connections, etc.)
 - Other conditions that might affect performance



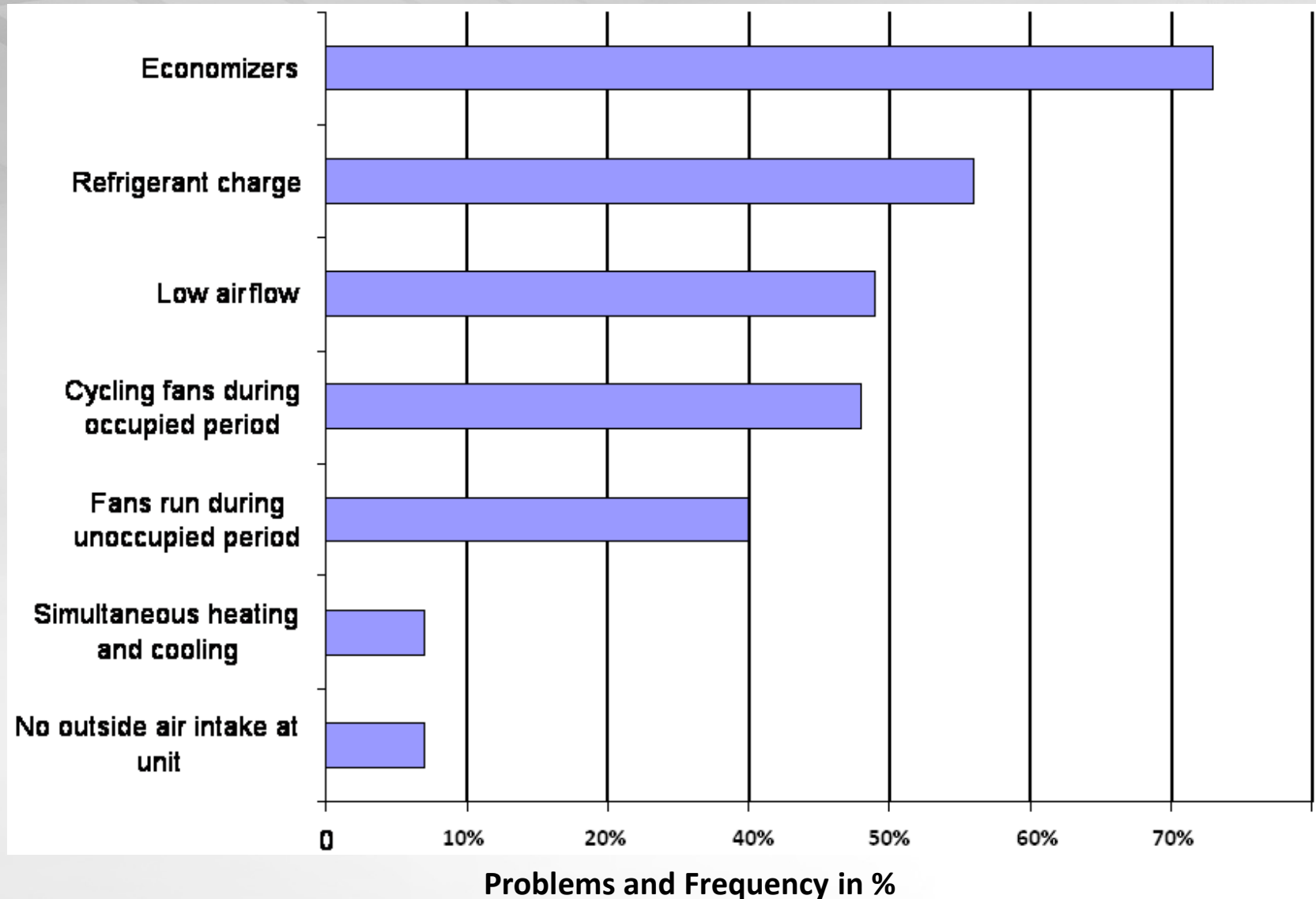
Source:

<http://www.achrnews.com/articles/rooftop-maintenance-checked> Dec. 11, 2012



Building Walk-Down: HVAC Systems

Typical Problems



Notice-Economizers are a problem in packaged equipment over 70% of the time

Source: New Buildings Institute - PIER



Building Walk-Down: HVAC Systems - Using Senses for Inspection

- ▶ Looking for problems – visually inspecting all parts of the unit is one way to find problems with the unit during maintenance
- ▶ Feeling for problems – feeling for air leaks is another way to find problems with a unit during maintenance
- ▶ Listening for problems – listen for unusual noises like thumps or banging, could be signs of a problem with a fan or other rotating mechanical and electrical components
- ▶ Smelling for problems – if a wire or component burns out, there usually is a burnt smell in the compartment of the unit, or an occupant of the building will let you know that they smelled a burning smell in the vents
- ▶ Use of our senses as a tool for troubleshooting can help find problems
- ▶ Most problems found (or prevented) during maintenance are discovered visually

Building Walk-Down: HVAC Systems - Visual Inspection

- ▶ What to look for
 - Missing or damaged panels/access doors or seals for them
 - Damaged indoor or outdoor coils
 - Missing or damaged mechanical items (fan motors/blades/belts)





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Building Walk-Down: HVAC Systems – Visual, Audible and Sensory Inspection

- ▶ What to look, listen and feel for?
 - Oil leaks or drips from the refrigeration system or components of the unit. This type of problem may require more training on how to properly handle refrigerant and should only be done by an authorized person
 - Coil condition – deteriorating due to corrosive air (salt water, etc)
 - Feel and listen for air leaks around exposed ductwork or the roof curb for a rooftop unit. This may be hard to fix, but it is wasting energy and should be identified
 - Refrigerant line sets should be adequately protected on split systems and packaged rooftop units
 - Low pressure suction lines should be adequately insulated for efficiency



Building Walk-Down: HVAC Systems - Visual Inspection

- ▶ Check the P-trap on the cooling coil
 - P-trap should have water in it, if the equipment is located in a mechanical space that does not freeze
 - P-traps that are located outside need to have water in them when the cooling is running and allowed to go dry when the weather changes to fall or winter.





Building Walk-Down: HVAC Systems - Visual Electrical Inspection

- ▶ Burnt or disconnected wiring/electrical components
- ▶ Smell for burning wires or burning oil
- ▶ Burnt wires are a sign that the connection is loose or the wire was undersized for the load
- ▶ Tightening of electrical connections is something that should be done during regular maintenance
 - These connections are generally a screw/lug type of connection that can be tightened with a screwdriver, or Allen head wrench
- ▶ **ALWAYS FOLLOW ALL SAFETY RULES WHEN WORKING WITH ENERGIZED, ROTATING EQUIPMENT!**
- ▶ **LOCK & TAG REQUIREMENTS SHOULD ALWAYS BE FOLLOWED!**



Building Walk-Down: HVAC Systems - Visual Inspection of the Refrigeration Section

- ▶ Check the refrigerant charge, using manufacturer recommended procedures
 - Should be done by a trained professional
- ▶ Check current (amp) draws in the compressor and condenser fan
 - Should be done by a trained professional
 - Current draws exceeding the nameplate rating indicate potential problems
 - Bearing failures, high refrigerant charge, capacitor failure
- ▶ Check the crankcase heater with a temperature gun; if the temperature is close to the ambient, it is probably not working
- ▶ With power off: lubricate the condenser fan, and check the bearing for tightness
- ▶ Check the contactors or motor controls to ensure all relays and contactors are working properly (listen – there should be no chattering)
- ▶ Check the run/start capacitor(s) to ensure that they are not leaking oil or bulging (a sure sign of imminent failure)



Building Walk-Down: HVAC Systems - Visual Inspection of Fan Section

- ▶ Note what type of fan is installed
 - Is the fan direct drive, or is the fan driven with belts
 - Direct drive fans will have the motor mounted in the fan housing
 - Belts driven fans will have the motor mounted outside of the fan housing on a base that is near the fan housing
- ▶ Look for debris in the fan wheel and in the fan section
- ▶ Look for insulation that has come loose and is hanging or fallen down inside the fan housing or ductwork
- ▶ If there is signs of belt debris, the belt is failing.
- ▶ Loose screws, bolts, etc.

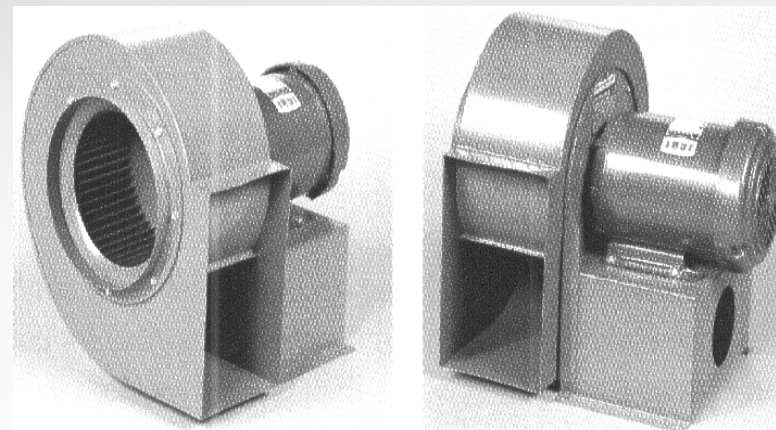


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Building Walk-Down: HVAC Systems - Visual Inspection of Direct Drive Fan Motors

- ▶ Visually Inspection:
 - Fan motor
 - Fan wheel
 - Fan housing
- ▶ Check the fan mounts
- ▶ Lubricate bearings and check fan bearings for tightness
- ▶ Ensure that the fan is rotating the correct direction (when power is applied to the motor)
- ▶ Most bathroom and general purpose exhaust fans are direct drive (but could be belt driven). When inspecting exhaust fans serving bathrooms or other general purpose areas, make sure they are controlled to shut off at night (time clock, programmable thermostat interlock or similar control).



Source:

<http://www.buffalofan.com/fanblower.html>

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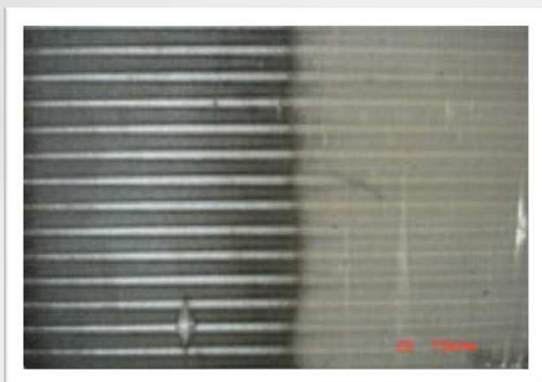
Building Walk-Down: HVAC Systems - Visual Inspection of Belt Driven Fan Motors

- ▶ Visually Inspect:
 - Fan motor
 - Fan wheel
 - Fan housing
 - Fan belts
 - Pulley/sheave are in good condition
- ▶ Check fan mounts
- ▶ Check fan bearings for tightness
- ▶ Ensure that the fan is rotating the correct direction
- ▶ Check pulley alignment
- ▶ Listen for unusual noises or vibrations



Building Walk-Down: HVAC Systems - Visual Inspection of Coil Section

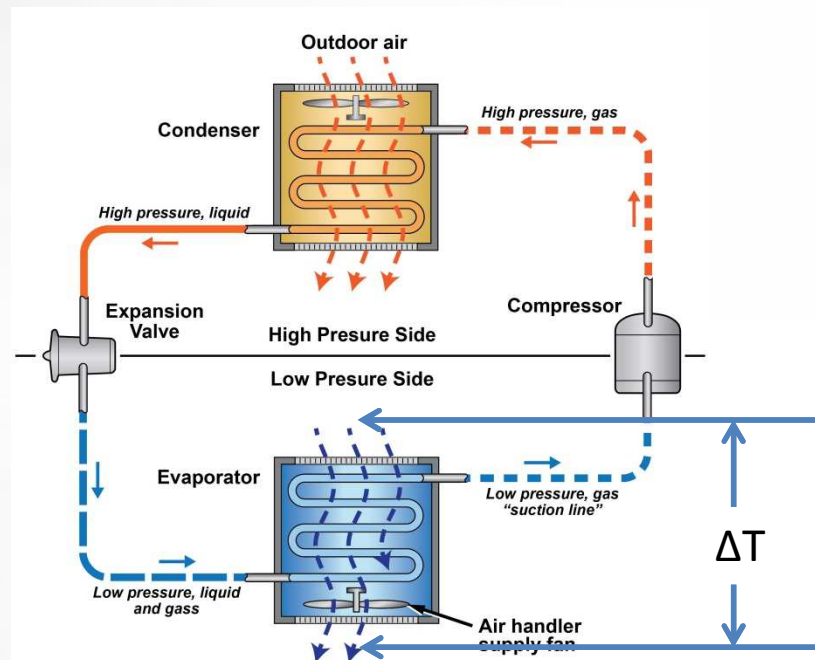
- ▶ Visual Inspection
 - Are the indoor/outdoor coils and fins dirty?
 - Is the coil damaged or leaking?
- ▶ Is the drain pan and drain line clean and clear of debris?
- ▶ In cooling mode, measure the temperature difference across the evaporator coil when the compressor is on; it should be 18 to 22°F for a single compressor unit or multi-compressor unit that is fully loaded.



Source:

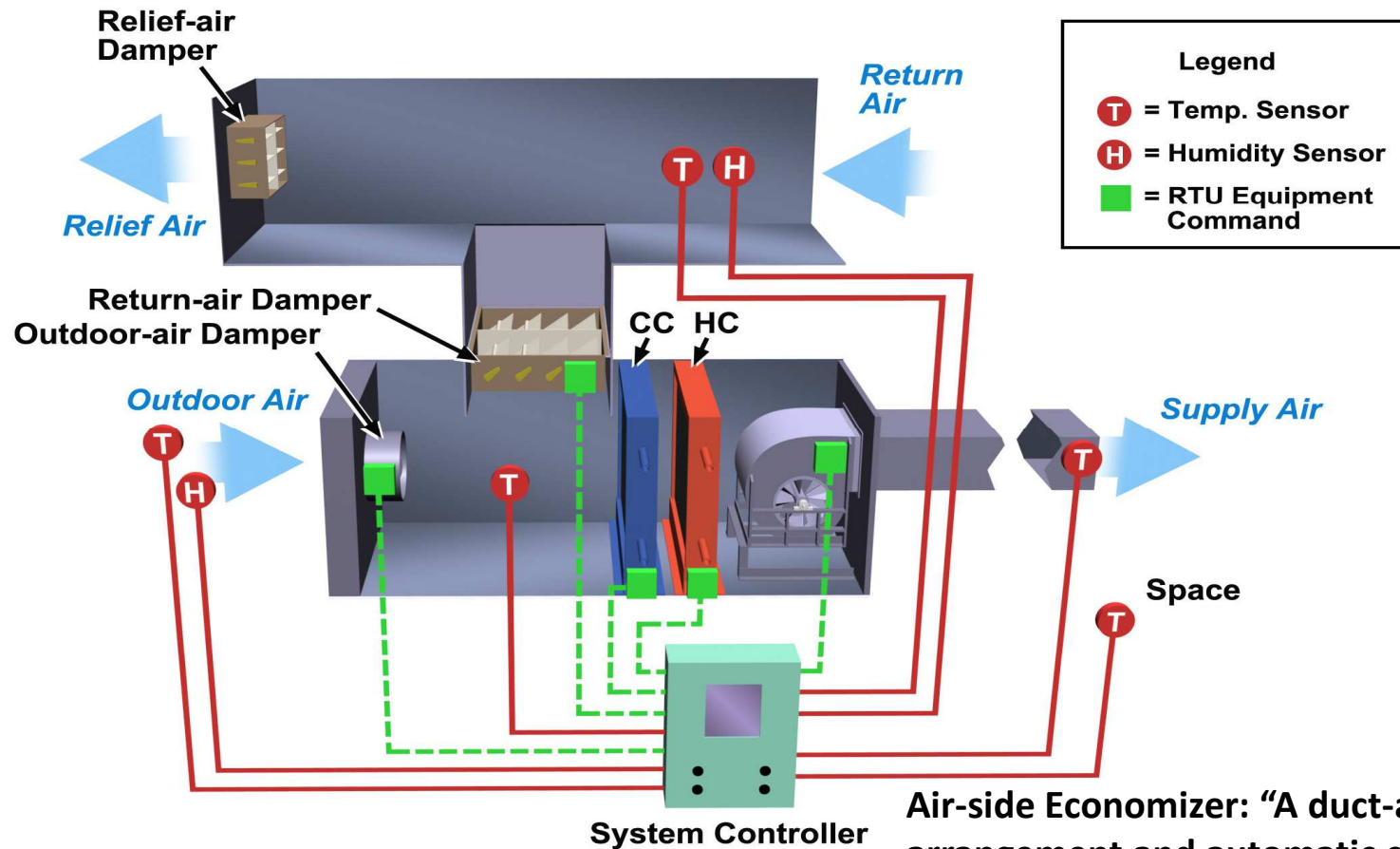
<http://www.amistee.com/commercial-coil-cleaning-mi.htm>

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Economizer Fundamentals

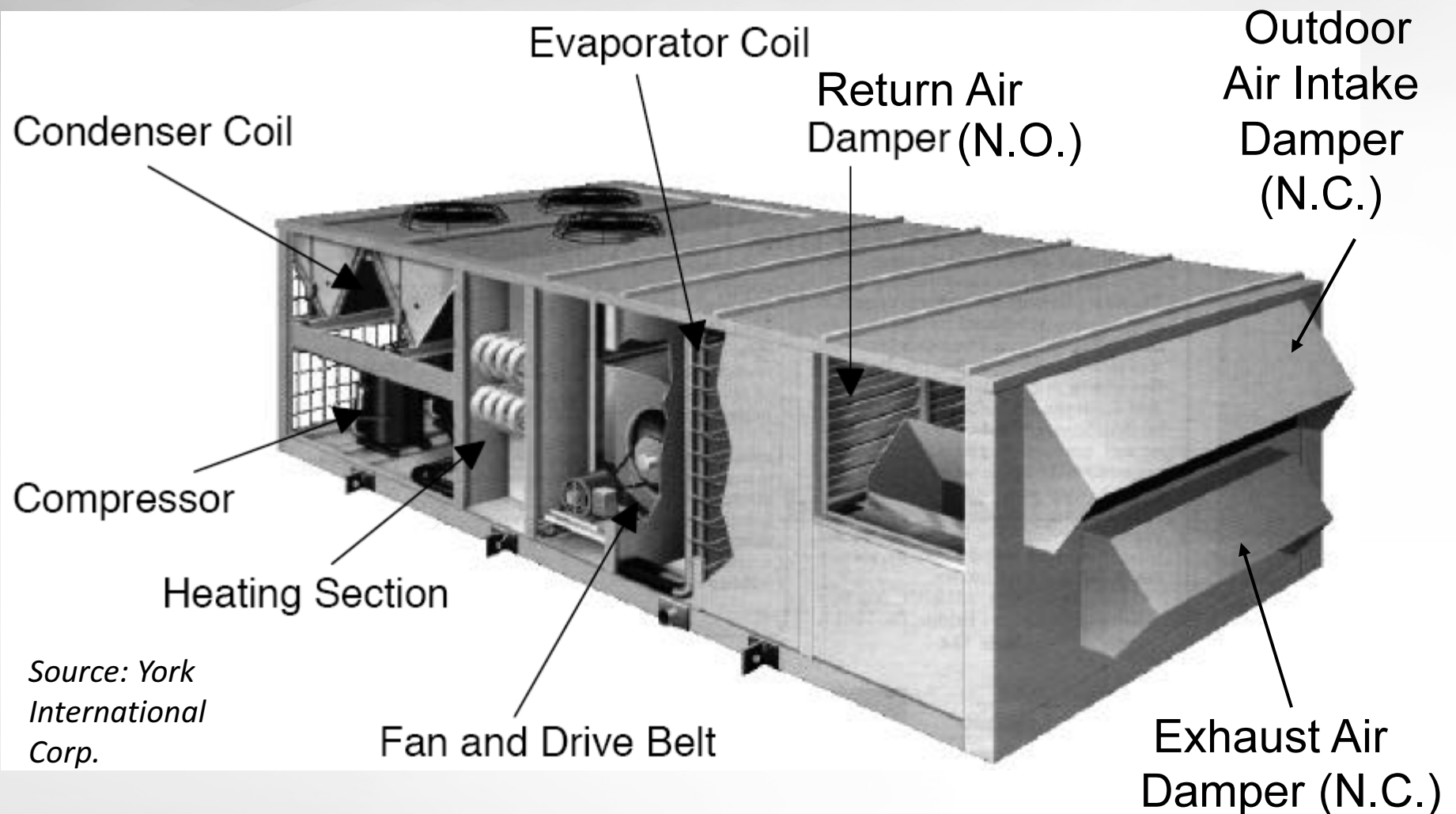
The Basics of Air-side Economizers



Air-side Economizer: "A duct-and-damper arrangement and automatic control system that, together, allow a cooling system to supply outdoor air to reduce or eliminate the need for mechanical cooling during mild or cold weather." (ASHRAE Standard 90.1-2004)

Economizers on Rooftop Units: Major Components

Notice dampers are either normally open (N.O.) or normally closed (N.C.)

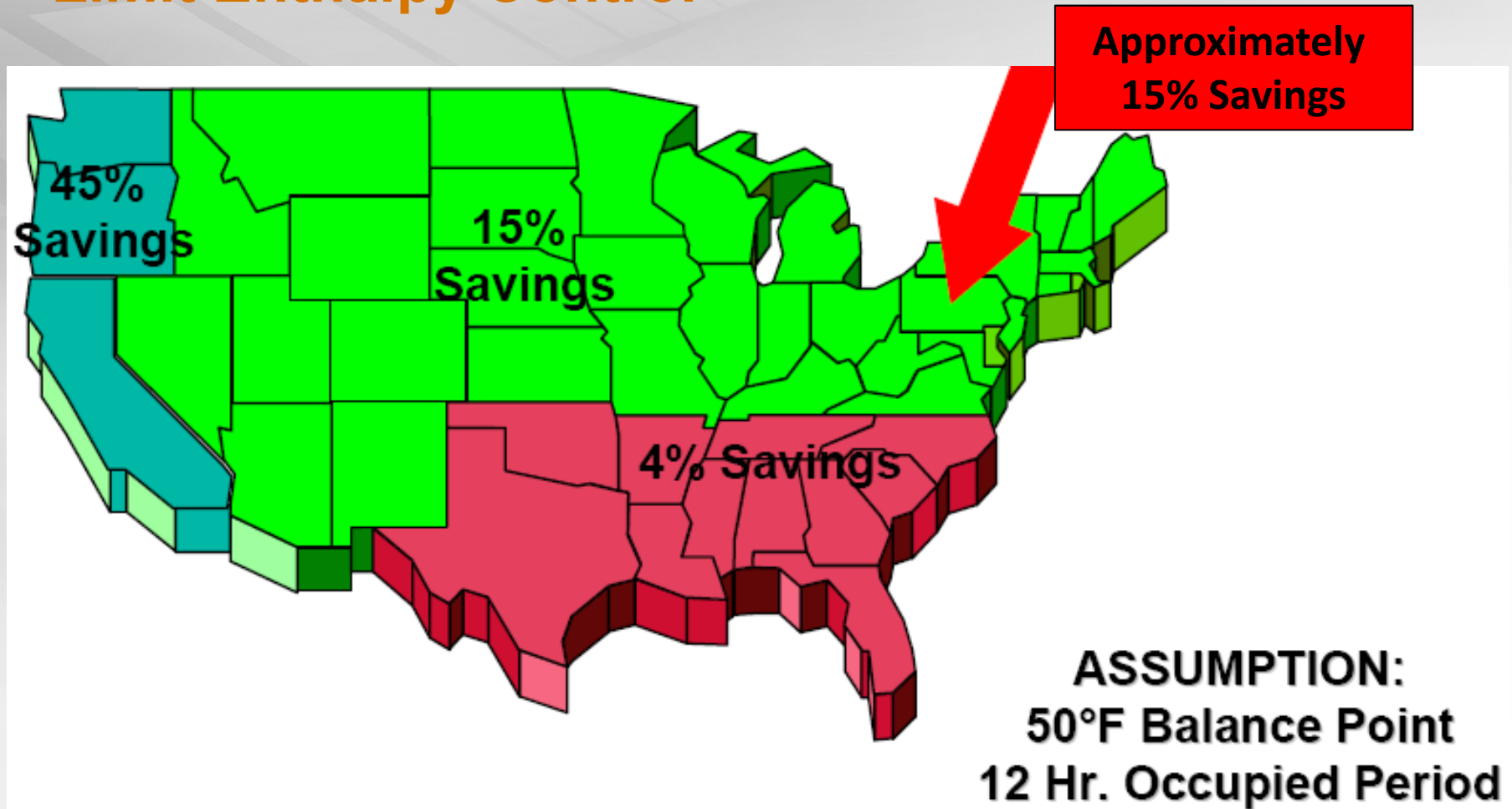




Economizer (continued)

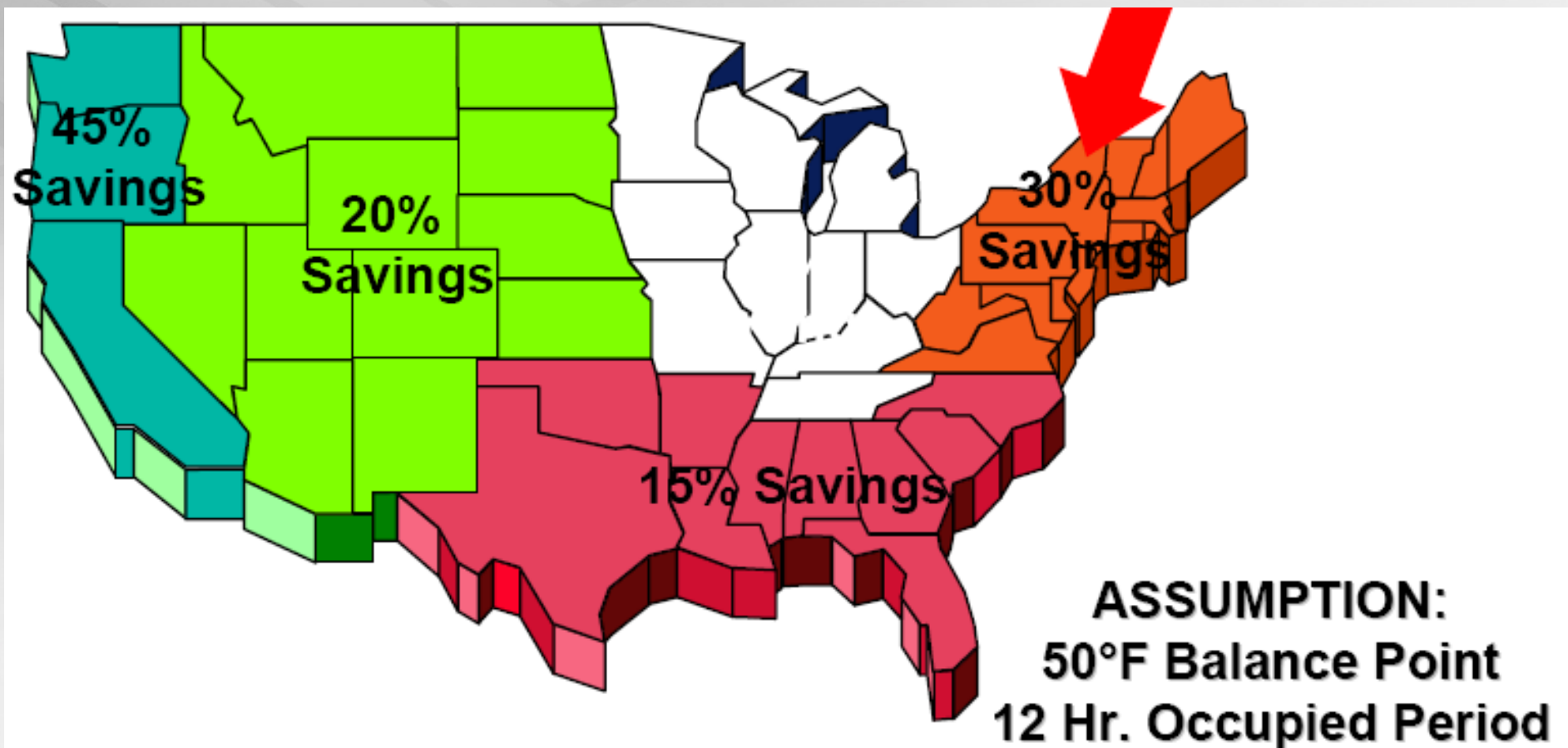
- ▶ Reality:
 - Air-side economizing uses unconditioned outdoor air to cool (or heat) a space
 - There are 2 air streams we can use for makeup supply air - outdoor and return
 - Dampers need to be sequenced together to mix and balance air flow streams to match needs of rooftop unit discharge conditions
 - As long as the outdoor air has a lower heat content than the return air, we should be using it even if mechanical cooling is required
 - In humid climates, use economizers when outdoor air is 5°F to 10°F below return-air temperature (dry-bulb control)

Potential Economizer Savings from High Limit Enthalpy Control



Source: Honeywell
Controls

Potential Economizer Savings from Differential Enthalpy Control



Source: Honeywell
Controls

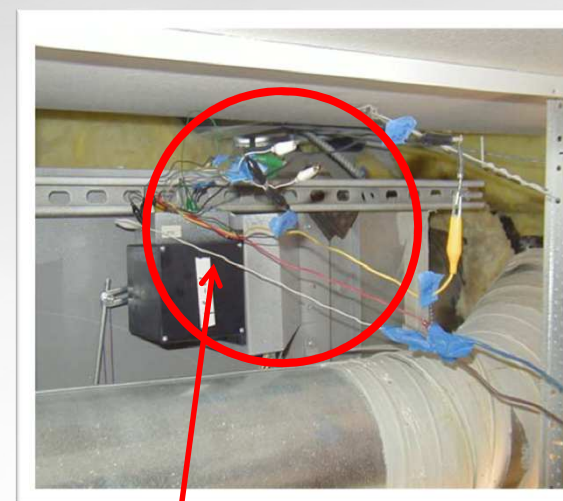


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Building Walk-Down: HVAC Economizer Components - Common Problems

- Jammed or frozen outdoor-air damper
- Broken and/or disconnected linkages
- Nonfunctioning actuator or disconnected wires
- Malfunctioning outdoor-air/return-air temperature sensors
- Malfunctioning controller
- Faulty control settings
- Installed wrong or wired incorrectly



Wired poorly



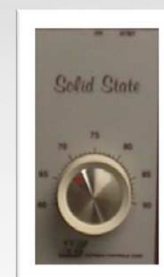
Jammed/Frozen Damper



Disconnected Damper

Building Walk-Down: HVAC System Controls

- ▶ Small/medium-sized commercial buildings typically lack central controls
- ▶ Typically have wall mounted thermostats to control both heating and cooling systems
- ▶ While surveying the thermostats and their capabilities, check:
 - Type of thermostat?
 - Mechanical or digital?
 - If digital, is it programmable?
 - If mechanical, replacing it with a programmable digital thermostat will save energy, if it is properly programmed





Building Walk-Down: HVAC System Controls

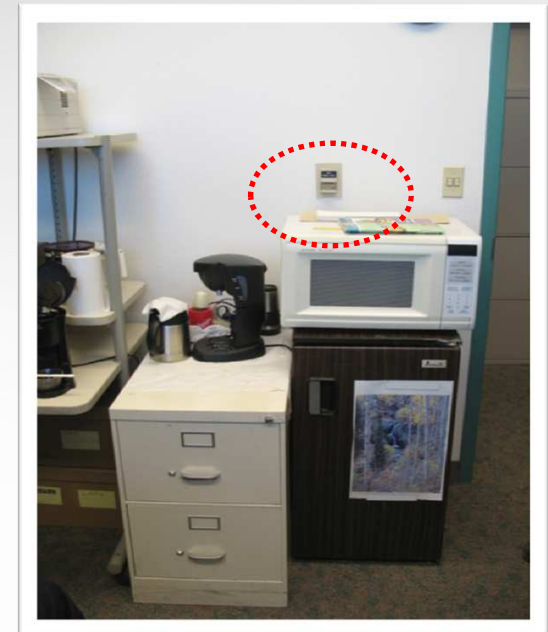
- Thermostats

- ▶ If the thermostat is digital programmable, what features does it support?
 - 7-day scheduling?
 - Holiday scheduling?
 - This feature is not a commonly supported feature, however, it increases savings
 - Optimal start/stop?
 - A remote sensor (outdoor air)?
 - If an outdoor-air sensor is used, where is it located?
 - Ideally, the sensor needs to be located on the north side of the building, under a solar shield
 - If an outdoor-air sensor is installed, are heat pumps using it to lockout second stage heating when outdoor air is greater than 40°F. For newer equipment it could be even lower, check manufacturer recommendations



Building Walk-Down: HVAC System Controls - Thermostats

- ▶ Check the location of the thermostat
 - Make sure that the thermostat is not placed close to a heat source or behind things that will impede their ability to sense the room temperature
 - Thermostats need to be located on interior walls not on exterior walls, also not in direct sunlight
 - Is there a draft of air coming from behind the thermostat that will affect the temperature that the thermostat is sensing?
 - Make sure there are no overrides on the thermostat (“Hold” feature) that prevent setback (unoccupied) actions from occurring

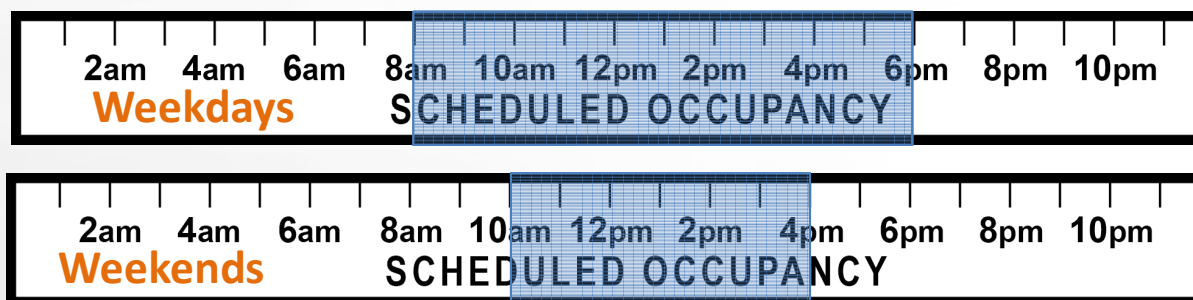




Building Walk-Down: HVAC System Controls

– Programmable Thermostat Schedules

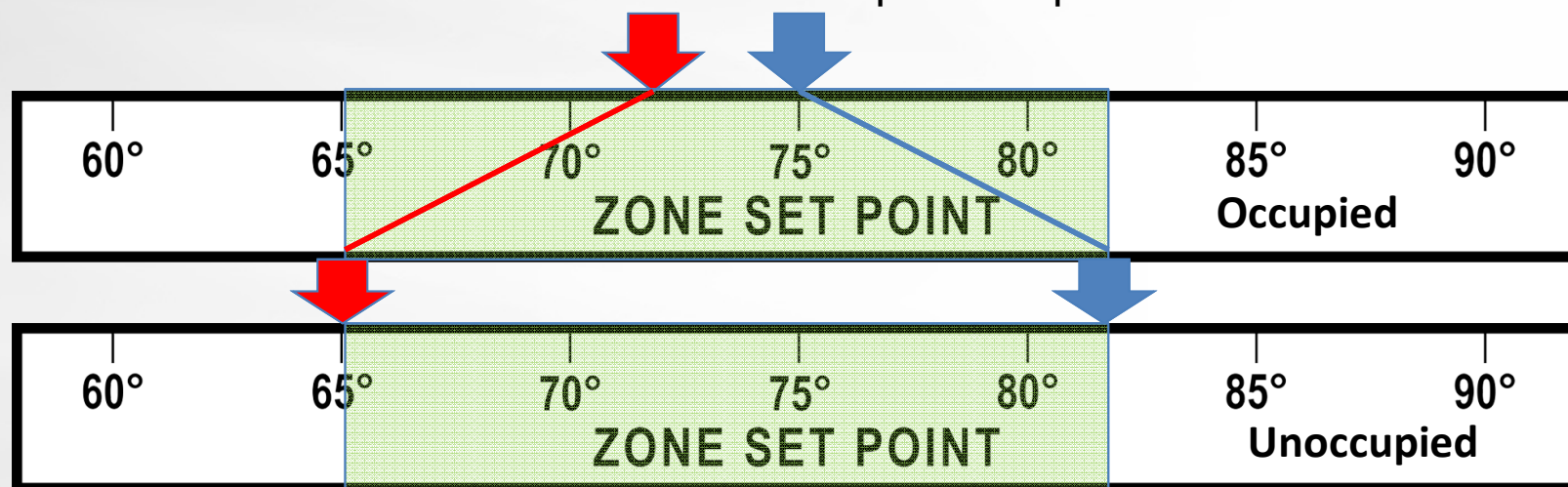
- ▶ If the building has programmable thermostats, what type of scheduling capabilities do they have?
 - **5+2 – one weekday and one weekend**
 - **5+1+1 – one weekday and two weekend**
 - **7 day – schedule for each day of the week**
 - How many scheduled operations per day?
 - Are the weekday schedules consistent with the building operations?
 - Are weekend schedules enabled and are they consistent with the weekend operations?
 - If it supports holiday schedules, are the holidays programmed?





Building Walk-Down: HVAC System Controls – Programmable Thermostat Set Points

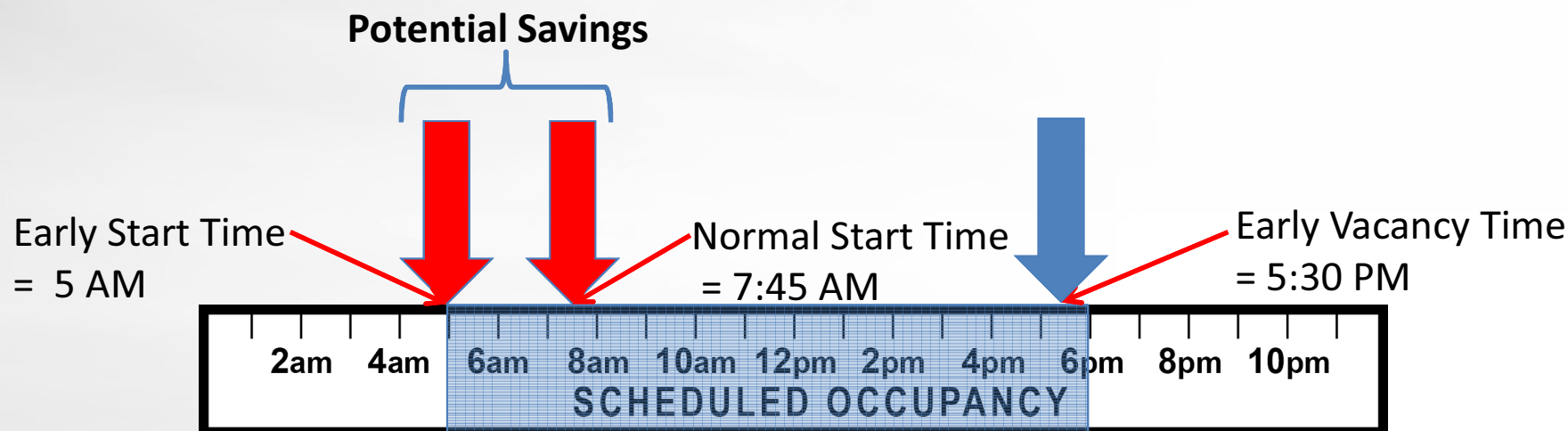
- ▶ Check the set points
 - Are there unoccupied set back and set up set points?
 - Is there at least 5°F difference between occupied and unoccupied set points? Is there at least 2°F difference between occupied heating and cooling set points? If not, recommend widening to a minimum of 2°F.
 - In heating mode, the recommended occupied set point is 72°F and the recommended unoccupied set point is 65°F
 - Similarly, in cooling mode, the recommended occupied set point is 75°F and the recommended unoccupied set point is 82°F





Building Walk-Down: HVAC System Controls – Programmable Thermostat Optimal Start

- ▶ Optimal Start (OS) is a feature that can save energy over traditional scheduling programs
- ▶ Most schedules are configured to start the HVAC system at the time it would take to heat or cool the space under worst case conditions
- ▶ OS will automatically “learn” over time, the optimum time to start the HVAC system to bring space temperatures within 1 to 2°F of occupied requirements at the start of the occupied time period





Building Walk-Down: HVAC System Controls

– Programmable Thermostat Fan Control

- ▶ Is the programmable thermostat in “Fan-Auto,” which means that the fan is cycling with the cooling compressor and/or furnace?
- ▶ If the thermostat is in “Auto,” (instead of “On” or “Run” in Occupied Mode) it can lead to lower ventilation rates than required, especially during spring and fall seasons, when cooling/heating needs are at a minimum
- ▶ Commercial building codes may require the RTU supply fans be running continuously to provide adequate ventilation during occupied modes

Lighting System and Controls

PART OF THE INDOOR AND OUTDOOR BUILDING WALK-DOWN



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Building Walk-Down: Inside Lighting Systems and Controls

► Inside lighting details

- Do they have any lighting controls – manual switches, dimmers or time clocks?
- Type of lights (T-12, T-8, T-5, LED, CFL, Incandescent?)
- Are proper light levels being maintained or over-lit?
- Is there opportunity to de-lamp?
 - Use light meter to verify that light levels meet IES (Illuminating Engineer Society) recommendations and/or user needs for the spaces.
 - Day lighting opportunities?
 - Educational signs at manual light switches (as in figure at bottom right of the slide)?
 - Are lamps and fixtures clean?





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Building Walk-Down: Exterior Lighting Systems and Controls (continued)

► Outside lighting details

- What type of lights are used outside the building in parking lots and other places?
- Number of lights?
- Are they controlled with photocell or any other time-of-day control system (time clock)?
 - Is the photocell working correctly (location)?
 - Exterior lights on during the day or coming on too early or staying on too late?



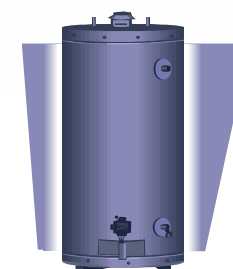
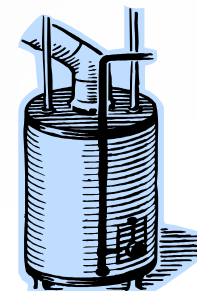
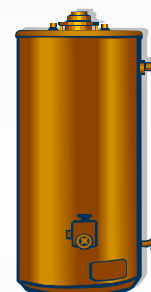
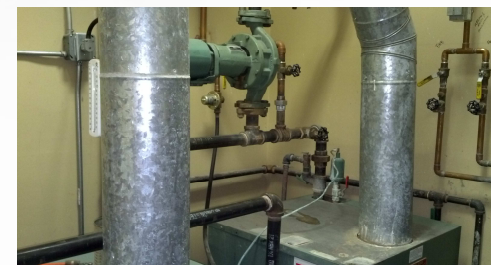
Hot Water Systems

WALKING-DOWN THE INSIDE OF THE BUILDING

Building Walk-Down: Hot Water Systems

► Hot Water Systems

- Type of hot water system – domestic hot water or heating hot water or both?
- Energy Star rated appliances?
- Domestic hot water temperature?
- Are the tanks insulated?
- Are the plumbing lines insulated?
- Are there any observable leaks?
- Faucets leaking?
- Relief Valves leaking?
- Zone heating controls in place and working?
- Set back controls in place and working?





Building Walk-Down: Hot Water Systems

- ▶ Check the following list by analyzing the control and operation:
 - ❖ Is the boiler on during hot summer hours?
 - ❖ Is the hot water supply temperature resettable?
 - ❖ Is the differential pressure reset for hot water pump control?
 - ❖ Does the hot water system turn off at night and have lockouts?
 - ❖ If the building has condensing boilers, what is the return water temperature?
 - ❖ Is there maintenance done to the steam traps?

Office Equipment

WALKING-DOWN THE INSIDE OF THE BUILDING

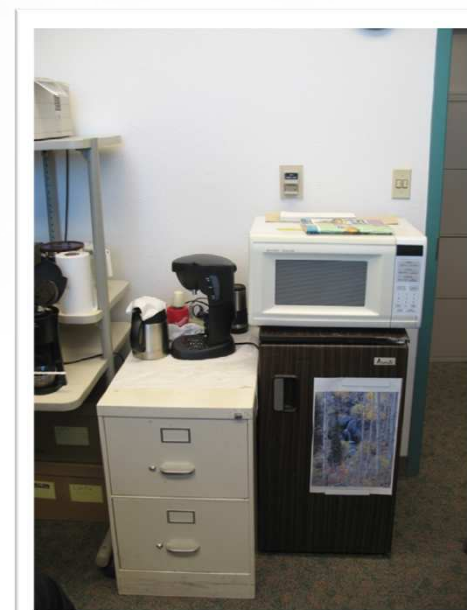
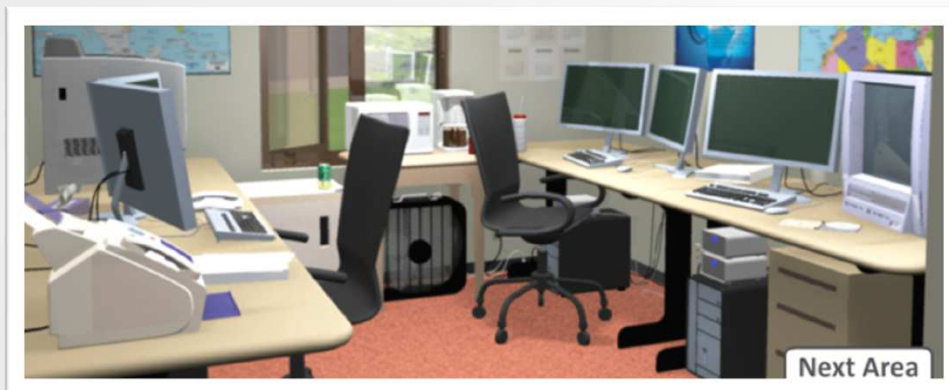


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Building Walk-Down: Office Equipment

- ▶ Over the past 2 decades use of office equipment increased significantly and still continues to increase
- ▶ There is not much that can be done with the office equipment other than inform staff to turn them off when not in use (weeknights and weekends)
- ▶ Some computer equipment can be setup to automatically go into a energy saving mode, if they are configured properly
- ▶ While walking-through the building, notice if computer screens are off when the office is not occupied
- ▶ Are portable space heaters or fans running in unoccupied spaces?
- ▶ Energy Star rated appliances and computing resources?



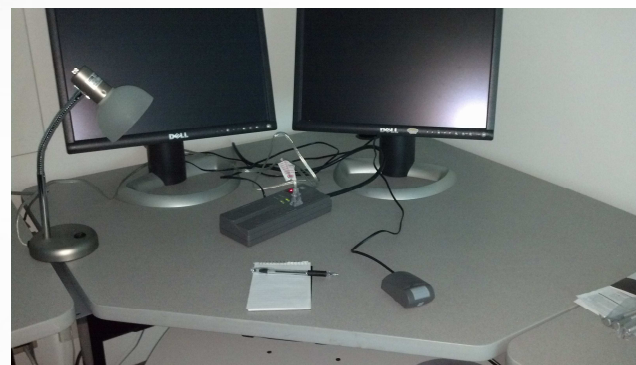
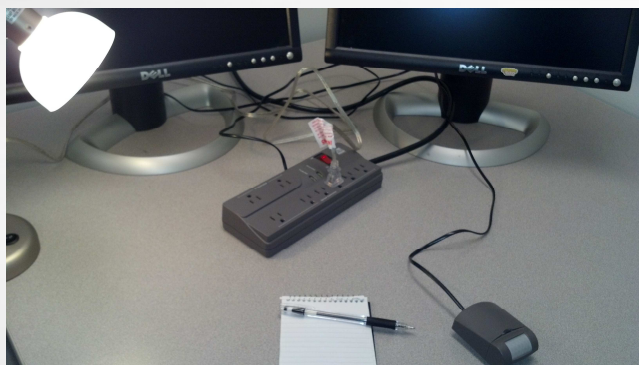


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Building Walk-Down: Office Equipment Occupancy Sensor control

- ▶ Many vendors now make occupancy-sensor based plug load controllers
- ▶ These can be wall strip or outlet strip
- ▶ They usually have a built-in occupancy sensor and timer that can be adjusted to eliminate nuisance trips
- ▶ Only non-critical loads should be connected (monitors, printers, speakers, lamps, fax machines, radios, coffee pots, etc.)



Indoor Environmental Quality

WALKING-DOWN THE INSIDE OF THE BUILDING

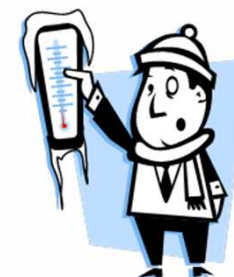
Building Walk-Down: Indoor Environmental Quality

- ▶ While walking inside the building, use the temperature gun and make spot measurements to note the temperature
 - What is the typical temperature?
 - Does it feel unusually dry or humid?
- ▶ Talk to people to get their view on the general comfort in their rooms
 - How does the building temperature and humidity feel to the occupants
- ▶ Check conference rooms. Are they too hot or too cold?



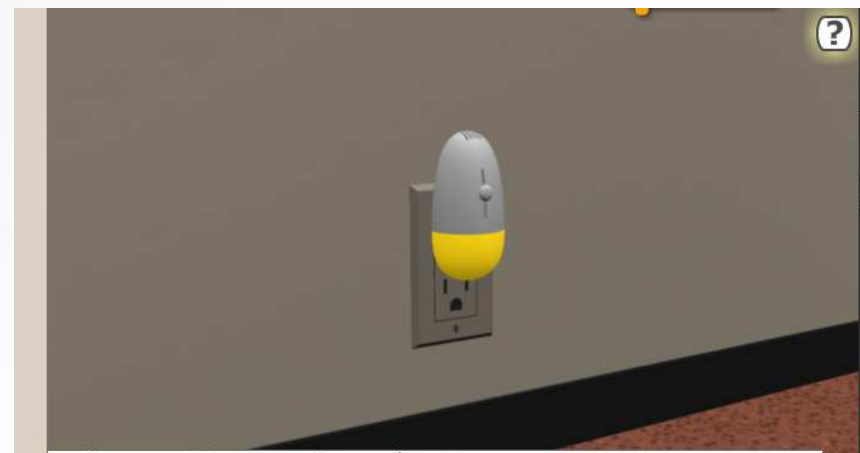
Building Walk-Down: Indoor Environmental Quality

- ▶ Look at discharge air diffusers. Are they fully or partially closed?
 - Closed or partially closed diffusers can be signs of discomfort
- ▶ Are the return air grills blocked or covered?
- ▶ Look for space heaters in offices
- ▶ Are there areas that are stuffy or have unusual odors?



Building Walk-Down: Indoor Environmental Quality

- ▶ A musty smell often indicates that this area of the building is not properly ventilated. This situation may or may not be an energy issue, but it is definitely a comfort issue. If the building is not properly ventilated, not enough fresh outside air is coming in.





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Assessment of Air Distribution System (Ductwork)



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Building Walk-Down: Air Distribution System

- What to Look for

- ▶ Indication of a big leak
 - If both the space(s) served by the ductwork and the area that the ductwork runs through are at or near the same air temperature
 - Access to attics and crawl spaces is necessary to verify ducts – be careful when in these spaces
- ▶ Ductwork that is crushed or flattened
- ▶ Ductwork that is sagging or no longer attached to its support hangers
- ▶ Dirt/dust trails near joints or seams in the ductwork
- ▶ Tape or insulation that is not attached or hanging from the ductwork



Source:

<http://ardenenvironmental.blogspot.com/2010/11/duct-blast-testing.html>

Dec. 11, 2012





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Building Walk-Down: Air Distribution System

- ▶ Studies show between 10% and 30% of the conditioned air (heated and cooled for comfort) is wasted because of leakage thru ductwork
- ▶ For new construction, <10% air loss is considered the “acceptable” expected air loss when putting in a new ductwork system (per SMACNA & ASHRAE)
- ▶ Air leakage may increase over time because of:
 - Construction (adding to or disturbing the ductwork)
 - Damage (maintenance/other activities)
 - Exposure to the outdoor elements causing damage to the duct material
 - Operational changes in duct static pressure set points (increased static)



Source:

<http://www.thecharlottehomeinspectors.com/node/36>

Dec. 11, 2012



Source:

<http://www.reliablecomfort.com/blog/?Tag=duct>

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Building Walk-Down: Air Distribution System

- ▶ Ductwork that is not sealed correctly can cause the building to become depressurized. This can allow unconditioned and unfiltered air into the building. This can lead to health problems for the occupants of the building.
- ▶ Improperly sealed ductwork can lead to comfort problems
 - Sometimes it will only show when the building is subjected to temperature extremes that are at or near the design temperature of the building design conditions.
- ▶ The potential for duct leakage can also be validated by air balance efforts that document supply fan air flows (duct traverse readings) which should closely match the total air flows measured at all connected diffusers (measured with a hood flow apparatus).
- ▶ Un-insulated ductwork is almost as bad as leaky ductwork
 - Although the air is not leaking, there is significant heat loss/gain as the conditioned air flows through un-insulated ductwork. This can be even more pronounced when the ductwork is in attic spaces or on roofs, exposed to hot or cold temperatures.





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Building Walk-Down Air Distribution System - What to Look for

- ▶ Flexible ductwork joints/seams are good candidates for leaks. They are especially susceptible to leaking when located on the outside of a building or exposed to the outdoor elements indirectly.
- ▶ Plastic tie bands should be used to reconnect flexible duct to metal collars. Duct tape should only be used for securing insulation to the duct.
- ▶ Roof curbs are another area where air can leak. Roof curbs are the stand or mounting that the rooftop unit is sitting on, when installed on the roof. They are hard to check for leaks, but can be checked by running the fan and feeling around the ductwork for air leaks. The other option is to pull the cover on the unit where the supply and return duct come into the unit, and just reseal with a UL listed ductwork sealer.



Source:

<http://theenergygrid.com/homepower/>

Dec. 11, 2012

Building Walk-Down: Air Distribution Systems - What to Look for

- ▶ Look for insulation that is ballooned when the fan is running, and deflates when the fan goes off. This type of leak is harder to find because it requires removal of the insulation to find the leak
- ▶ Feel for air that is escaping at or around the registers, grills, and vents
- ▶ Vents that have no air flow are good candidates for leaking or broken ductwork
- ▶ Air movement in attics is also a sign of problems. Is there heated air in the winter and cool air in the summer?
- ▶ If attic spaces are adequately insulated, but snow seems to melt quickly from the roof, this is an indicator of heated air getting into the attic that should be further explored.



Source:

http://www.energystar.gov/index.cfm?c=behind_the_walls.btw_ducts

Dec. 11, 2012



Source:

<http://www.greencatservices.com/duct.html>

Dec. 11, 2012