

Key Concepts

Module overview

Explanation

This Bathroom Module is part of a larger course on energy efficiency in remodeling.

Although a remodeling project may involve only one room of the house, the project can affect other parts of the house because a house works as a system. For example, installing a Jacuzzi tub in a bathroom may affect hot water supply at other locations throughout the home; or, a ventilation fan installed as part of a bath remodel could be used as part of a whole-house ventilation strategy. Therefore, attention to the bigger picture as well as the details is needed to ensure that the final product is a bathroom that suits the customers' needs and enhances the entire home.

Action Items

Resources

Bathroom Remodeling Course Objectives

- Identify opportunities to improve comfort and save energy during a bath remodeling project
- Enhance customer satisfaction by selecting materials and equipment that are durable, quiet, energy efficient ... and that fit the customer's functional and aesthetic requirements

Key Concepts

Course objectives

Explanation

Identify opportunities to improve comfort and save energy during a bath remodeling project.

Enhance customer satisfaction by selecting materials and equipment that are durable, quiet, energy efficient ... and that fit the customer's functional and aesthetic requirements.

Action Items

Resources

Bathroom Remodeling Opportunities for Energy Savings

- Hot water
- Lighting
- Insulation
- Air sealing
- Ventilation

Related issues

- *Comfort*
- *Durability*
- *Moisture control*

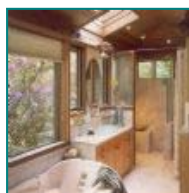


Photo: NKBA



Photo: Brothers Strong, Houston, TX



Key Concepts

Overview of opportunities to improve comfort and save energy during a bathroom remodeling project

Explanation

The five key areas for energy efficiency in a bathroom remodeling project include hot water, lighting, insulating, air sealing, and ventilation. In many cases, enhancing energy efficiency in the bathroom also leads to improved comfort and durability and reduced risk of moisture problems.

Action Items

In the course of a bathroom remodeling project, be aware of energy saving measures that can reduce homeowner utility bills, improve comfort in the bathroom, and reduce the risk of moisture problems.

Resources

ENERGY STAR <http://www.energystar.gov>

Home Energy Magazine <http://www.homeenergy.org>

No Regrets Remodeling (available through Home Energy Magazine), a 200-page guide to energy efficiency in remodeling. Includes diagrams, worksheets, definitions, and concise explanations. An excellent resource for a remodeler interested in energy efficiency.

Energy Efficient Rehab Advisor (U.S. HUD) <http://rehabadvisor.pathnet.org>



First Visit: Assessing Energy-Related Issues

Are there ...?

- Hot water problems (e.g., insufficient pressure, inadequate supply, high/low temperature)
- Comfort issues (e.g., air temperature, drafts)
- Lighting - adequate natural/artificial light
- Musty odors
- Proper ventilation fan performance and operation



4

Key Concepts

Assessing potential areas for improvement on first site visit

Explanation

When you first discuss a job with a potential customer, it is important to assess areas for energy improvements. Take note of existing conditions yourself, or ask the homeowner some of the above questions. Talking about issues such as hot water supply can lead to solutions that can create a happier customer...leading to more referrals for you! The homeowner may not realize that some of these problems can be fixed during the remodeling project—and your knowledge and attentiveness to detail can improve the customer's satisfaction with the job!

Action Items

On the first site visit for a bathroom remodeling project, observe key areas for potential improvement. Use the checklist that is provided with you on your first site visit. When looking at the project, note any checklist items that might need to be addressed. E.g., Does the room smell musty? Is it colder/warmer than the rest of the house? Is the ventilation fan especially noisy? (Tip: One way to assess the performance of a bath fan is to hold a piece of paper up to the grille. Is the fan strong enough to "hold" the paper unassisted?)

Resources

Instructor's Note

Ask the students how often they have encountered any of the following problems when a customer has called them to update a bathroom:

- Long waits for hot water
- Shortage of hot water
- Bathroom is too hot or cold
- Bath fan doesn't seem to remove moisture

Bathroom Remodeling Hot Water Energy Savings

- Leak repair
- Low-flow fixtures
- Insulation
- Air sealing
- Supplemental heat
- Lighting
- Ventilation



Key Concepts

Saving hot water energy in the bathroom

Explanation

There are several solutions that can be implemented during a bathroom remodel which will save water heating energy including adding insulation, using efficient equipment and distribution systems, installing low-flow fixtures, and repairing leaks. Since bathroom hot water use makes up about 60% of total household hot water use*, minor changes to the hot water system can have a significant impact on household hot water energy use. Additionally, many people complain of running out of hot water, uneven hot water delivery temperature, or other hot water issues. Often, hot water energy-saving measures also resolve these other issues—and, therefore, you have created a solution that goes beyond customer expectations.

Insulation: It often makes sense to add a water heater insulating blanket and/or heat traps on the inlet and outlet of an old water heater, especially if located in unconditioned space. Sometimes it pays to add hot water pipe insulation.

If new hot water piping is needed, consider a PEX (cross-linked polyethylene, a flexible plastic) manifold system which reduces pipe size and can thus reduce hot water waste. The flexible PEX piping is usually easier to run through existing walls than rigid piping. With any plumbing material, don't oversize piping. Using the code minimum size will minimize energy and water waste.

If a water heater is being replaced, high efficiency water heating equipment will save energy. Use the yellow EnergyGuide label to compare the efficiency of various units--there is currently no ENERGY STAR rating for water heaters.

The next few slides will cover low-flow fixtures and leak repairs.

Action Items

For more information about water heating energy efficiency, see the Mechanical Systems module.

Talk to the homeowner about hot water supply issues. Discuss energy use in the bathroom.

Use high efficiency water heating equipment when replacing or adding a water heater.

When new hot water piping is needed, consider a PEX manifold system. When installing new piping (whether PEX, copper, or PVC), don't oversize piping. Instead, use the code minimum size.

Water Leaks

Small faucet drips add up
(and cause major damage)!

- Average home loses 3 gallons per day in water leaks
 - **One-third is hot water**
- One in five toilets leak
- Detect leaks by reading water meter, adding food coloring to toilet tank, and watching for dripping faucets



Key Concepts

Energy and water usage resulting from leaks

Explanation

One of the simplest things you can do is to repair leaky faucets. A small faucet drip can add up to large water waste and, if its hot water, a lot of energy waste.

According to one Seattle study (DeOreo and Mayer, 2001), leaking pipes and dripping faucets account for 3.1 gallons per day per household on average. Twenty-seven percent (about 1 gallon) of that leaking water was hot water.

According to the American Water Works Association, one in five toilets leak.

You or the customer can detect water leaks by: turning off all the water in the house, reading the water meter, and reading it again in a couple hours. Put a few drops of food coloring in the toilet tank. If the color shows up in the bowl, there is a leak.

Photo: leaking shutoff to hose spigot saturated foundation wall and crawlspace.

Action Items

If faucets and toilets are not being replaced during the remodel, notice if there are dripping faucets. Listen for toilets that might run periodically even if they haven't been used. If so, talk to the customer about water leaks.

Resources

WaterWiser drip calculator: lets you type in the number of drips per minute and calculates daily and yearly water waste. <http://www.awwa.org/waterwiser/>

Water Saver Home Website describes how to detect leaks: <http://www.h2ouse.org>.

Hot Water Energy Savings Low Flow Fixtures

Showers and sink faucets

- About half of household hot water use

Low flow showerheads

- Use about one-third less hot water
- Saves \$10 to \$24 per year when replacing pre-1994 showerhead (~1 year payback)



Niagara 2.0 gpm non-aerating showerhead (EFI.org)



Key Concepts

Low-flow fixtures in the bathroom to save water and energy

Explanation

More than half of all household hot water is used in the bathroom (including tub baths). About half of all hot water usage goes to showering and bath sinks (LBL, 1994). Low flow fixtures—which often cost \$5 or less—are an excellent, cost effective solution in any bathroom having faucets pre-dating 1994. (Federal maximum flow rates for faucets were dramatically reduced after 1993). Consider replacing the fixture or adding an aerator for energy and water savings. This measure also helps resolve issues of hot water supply, since the hot water tank drains much more slowly during showering and sink use. One study of showerhead and faucet replacement with low-flow fixtures, conducted by the Lawrence Berkeley National Laboratory, identified a reduction in hot water use of about 12% (7 ½ gallons per day)—for a savings of about \$24 per year (12% of the average household expenditure of \$200 per year for hot water.**)

Not all showerheads are created equal. The aerating types may have a bad reputation because water temperature decreases with distance from the showerhead. However, other showerheads, such as the one pictured here, are non-aerating and therefore “feel” just like a typical showerhead.

In addition, although not directly energy-related, switching to a low-flow toilet can save lots of indoor water. In the average home, toilets make up for almost 30% of indoor water use. This figure can be cut in half (from about 60 gallons per day to 30) by switching to post-1994 toilets. In addition, there are ultra low flow toilets on the market, such as dual-flush models and pressure-assist that use less than the government-mandated 1.6 gallons per flush. (Design flaws in many of the early low flow toilets have been corrected; so, the multiple-flush syndrome has been largely alleviated.)

Action Items

Buy a low-flow showerhead for your own home, and talk to your customers from experience about the “feel” of the low flow.

Talk to your customers about the amount of water and hot water energy that goes to the bathroom and about how they can save water and energy with the remodeling project.

If faucets pre-date 1994, install new low-flow faucets and showerheads, even if they would not otherwise be replaced during the remodel.

Resources

Koomey, J.G., C. Dunham, and J.D. Lutz, 1994, The Effect of Efficiency Standards on Water Use and Water Heating Energy Use in the U.S.: A Detailed End-use Treatment, LBL-35475

**Energy Information Administration/Household Energy Consumption and Expenditures 1997, Department of Energy

Hot Water Energy Savings Low Flow Fixtures

Sink faucet flow restrictors

- Inexpensive and easy to install
- Laminar or aerated
- Available from 0.5 gpm to 2.2 gpm

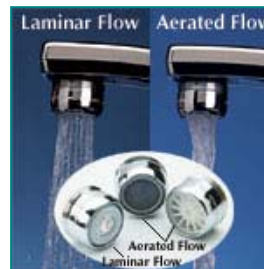


Photo: AM Conservation Group

Key Concepts

Low-flow faucet options

Explanation

As with showerheads, flow restrictors for lavatory faucets can take the form of aerators or laminar flow. Both are readily available, cost less than \$2, and are simple to install.

Laminar, non-aerating, flow devices don't mix air with water like conventional aerators do. Because the mixing of air with water has a cooling effect on the water (thereby potentially causing users to turn on more hot water to achieve the same delivery temperature) laminar flow devices may offer higher energy savings than aerators.

Action Items

If existing faucets were installed before 1994, they were most likely not low flow. Install a laminar flow restrictor in these faucets if faucets are not being replaced during the remodeling project.

Resources

<http://www.efi.org>--retail sales of energy conserving products, including faucet restrictors

<http://amconservationgroup.com>—manufacturer of laminar flow restrictors

Insulation and Vapor Retarders

- Use levels recommended by DOE
- Simple when walls are open to add or replace
- Fix when moisture problem suspected



Key Concepts

Insulating as an opportunity to improve comfort and reduce energy consumption

Explanation

Insulation can help improve the comfort of a bathroom by keeping interior walls warm. Cold walls, for example, can make people (especially bathers) uncomfortable through the radiant heat transfer from a person's exposed body to the walls. In addition, you can overcome existing condensation problems and reduce the risk of future problems by adding insulation properly.

There are a variety of insulation products available: fiberglass batts, sprayed cellulose, mineral wool, spray foam (like Icynene shown in the photo), and rigid foam. If walls are not being opened, you can use a blown-in insulation product. Most foams are not suitable for spraying into closed wall cavities, but some products are suitable such as cellulose, fiberglass, or cotton fiber. It is less important which type of insulation is used, but rather the overall R-value that is achieved and the quality of the installation. A good installation will fill all wall cavities and be uncompressed.

Rigid foam may be an option where higher R-value is desired in the wall cavity but space is tight. Foil-faced foam acts as a vapor retarder—and seams should be taped to prevent airflow. Extruded polystyrene and expanded polystyrene have perm ratings greater than 1.0 and are not considered vapor retarders.

Except for severely cold climates (HDD > 8,000), vapor retarders are not recommended – on either the exterior or interior of any exterior wall. Especially, in a bathroom where there is likely to be very humid air, it is almost impossible to completely seal the cavity against moisture penetration. It is best to allow the cavity to dry if it gets wet rather than try to achieve the probably unattainable goal of keeping all moisture or water vapor out. Do not use vinyl wallpaper in bathrooms – especially in hot humid climates. The vinyl is a vapor retarder.

It is important, however, to do a good job on air sealing exterior bathroom walls. Because air carries water vapor, if air is allowed to move through the wall, it is likely to condense when it reaches a cold enough point inside the wall cavity. In both hot and cold climates, it is a good idea to minimize – preferably eliminate – all air movement through the wall.

Kraft paper-faced insulation is one option but the paper should be stapled to the face of the studs – not the sides. A housewrap that has a high perm rating (>1) is another possibility. **In cold and mixed climates, consider a “smart” vapor retarder (e.g., CertainTeed’s MemBrain) that changes its resistance to vapor flow with relative humidity. In low RH, the perm rating of MemBrain is less than 1.0 (which means it classifies as a vapor barrier). When the RH is above 60, it’s rating is 10 perms, which means it will allow some vapor to pass through, thereby allowing a wall to dry. (Do not use MemBrain with**

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Air Sealing Typical Materials

- Air sealing can be a *simple, effective, and quick* task if you keep foam sealant, caulk, and gaskets on your truck
- Air sealing can *reduce drafts and prevent moisture* from migrating into wall cavities



Great Stuff window (left) and big gap (right) filler
www.dow.com/greatstuff



DAP water-based foam sealant www.dap.com



© Truserv Corporation



Backer rod photo wrmeadows.com

10

Key Concepts

Typical air sealing materials

Explanation

There are a variety of materials used for air sealing. Which product to use will depend on the application (e.g., are you filling a large hole or small crack?) and user preference. For example, backer rod and big gap filler are suitable for larger gaps while low-expansion foam should be used where expansion is undesirable (e.g., around windows).

Action Items

Be aware of the various air sealing materials. Practice using each one and determine which is best for you under different situations.

Resources

Instructor's Note

Bring in some of these small items to let your students actually see them. Demonstrate how to effectively (and neatly) run a bead of caulk. Examples of materials that could be brought in are caulk, foam, backer rod, aerators, low-flow showerheads, timers and fan controls, compact fluorescent bulbs

Bathroom Remodeling Air Sealing

- When moving or replacing walls, seal major sources of air leaks
- Air sealing measures can *improve comfort* and *prevent moisture* from getting into the wall



Key Concepts

Sealing air leakage pathways to improve comfort in a bathroom and prevent condensation problems

Explanation

Moving or renovating walls provides a good opportunity to increase the thermal performance of a bathroom. Air sealing is one of the most inexpensive, practical, and simple ways to improve comfort and reduce energy bills, especially in older homes. It only takes a few minutes to perform air sealing, but it can greatly improve comfort and reduce the risk of moisture problems and also save energy.

Air sealing can prevent condensation in walls, which can occur when moist air from the bathroom gets into the wall cavity and condenses on colder surfaces. Condensation problems may appear as: musty odors, mildew, peeling or bubbling paint or wallpaper, cracking plaster or warping drywall, among other signs.

Photo: Installing a solid air barrier on the interior stud surface improves insulation performance and reduces air infiltration. Photo also shows installation of air barrier at plumbing drain penetration.

Action Items

Have some air sealing supplies, such as foam sealant (e.g., DAPtex or Great Stuff, electric outlet and light switch gaskets), on your truck. Air sealing is much more likely to get accomplished if materials are readily available.

Resources

Keefe, David, Air Sealing in Occupied Homes, Home Energy Magazine Nov/Dec 1995, <http://hem.dis.anl.gov/eehem/95/951111.html>

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Air Sealing Common Pathways

- Windows
- Recessed lights
- Floor, ceiling, or walls at electrical wires, water pipes, drains, and vents
- Wall/floor connections on exterior walls




12

Key Concepts

Common air leakage pathways in bathrooms

Explanation

There are several common culprits of air leakage in a bathroom including around windows and exterior doors; through recessed lights; around switches and receptacles on exterior walls; around bath fans; around plumbing penetrations including water pipes, drains, and vent stacks; through dropped ceilings; at wall intersections; and gaps at the top of interior walls. Note that the practice of “chinking” (stuffing fiberglass batt insulation around windows) does little more than filter air flow. New low-expanding foam is designed for around windows and doesn’t bind the window like older foams could do.

Photo left: retrofit enclosure for recessed light made of drywall.

Photo right: air sealing top plate at plumbing wet wall from attic side.

Action Items

Be aware of common air leakage pathways and seal them when accessible. Review Building Science Basics module, and the Advanced Air Sealing book (listed in the resources) for information on methods.

For bathrooms with an accessible attic overhead, check the attic insulation for dark spots/staining, which may indicate areas of air leakage from the bathroom into the attic.


Resources

Advanced Air Sealing by Jim Maloney and Bruce Sullivan, 1993. Iris Communications. Available at <http://oikos.com/library/airsealing/index.html>

Virginia Energy Savers Handbook (Energy Use in Your Home)
http://www.mme.state.va.us/de/handbook_one.html

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Air Sealing Bathtub Drain



The diagram on the left shows a cross-section of a bathtub drain assembly. A blue arrow points to a gap between the tub and the floor joist, labeled "Air penetrations". The photograph on the right shows a person applying yellow foam sealant from a red can into the gap around a white PVC pipe.

Virginia Energy Savers Handbook

Building
AMERICA
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13

Key Concepts

Sealing the bathtub drain

Explanation

There are different methods for sealing around the large hole through which the bath drain penetrates. This is a key pathway to seal, if it is accessible during the remodel. Even if the tub drains through a second floor, this area can be a source of air leakage if the band joist is not well sealed and insulated. Another method that can be used to improve comfort is to insulate around tubs—it can help keep bath water warmer longer.

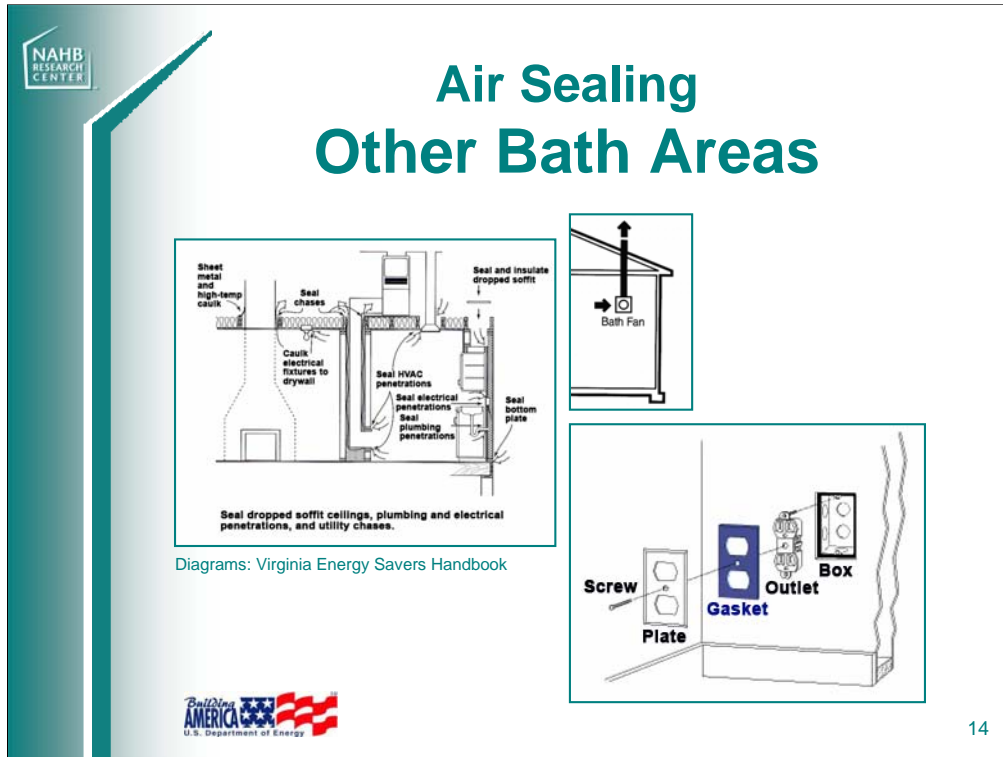
Action Items

Seal around the bathtub drain, if possible. Although a little awkward, the area could be sealed with pieces of rigid foam cut to “box in” the tub trap.

Resources

Advanced Air Sealing, <http://www.oikos.com>

Virginia Energy Savers Handbook,
<http://www.mme.state.va.us/de/handbook.html>



Key Concepts

Other areas for air sealing in baths

Explanation

There are numerous other areas for air sealing in bathrooms. For instance, around the bath exhaust fan housing, around fixture boxes or recessed light housings when they penetrate the ceiling to an unconditioned attic. Plumbing vents, HVAC registers, and receptacle boxes are other potential sources of air leakage. Like kitchens, dropped soffits are often used in bathrooms. It is important to make sure these are insulated and sealed.

Action Items

Look for opportunities to reduce draftiness in a bathroom during the remodeling process.

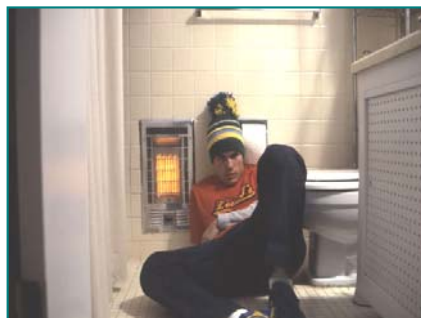
Resources

Maloney, Jim, and Bruce Sullivan, *Advanced Air Sealing (Electronic Edition)*, Iris Communications, available at <http://www.oikos.com> (direct link <http://oikos.com/library/airsealing/index.html>)

Bathroom Remodeling Space Heating/Cooling

Especially when adding square footage, determine:

- Is there *adequate ventilation*?
- Does the ductwork or radiator have *sufficient capacity* for heating and cooling?
- Is the room *too hot/cold*?



Key Concepts

Existing problems or changing conditions that may require changes in the mechanical systems serving the bathroom.

Explanation

The adequacy of the heating and cooling system serving the bathroom should be evaluated. If the remodeled room will have the same footprint as the existing room, and the homeowner is satisfied with the current conditions in the room, mechanical systems changes are unlikely to be required. However, if square footage is being added, or if the homeowner reports unsatisfactory conditions in the bathroom, then changes may be necessary. The remodeling process presents a good opportunity for implementing system changes.

Action Items

If you are adding square footage, enlist the help of an HVAC technician who will evaluate current conditions and recommend changes, if necessary. Also take into account air sealing and insulation improvements and ductwork repairs that could reduce the need to increase heating and cooling capacity.

If you are not adding square footage, talk with the homeowner about existing conditions: is the room too hot/cold? Does moisture linger in the bathroom? Is there a musty odor? Is there a problem with mold?

Resources

The Air Conditioning Contractor's Association (<http://www.acca.org>) publishes industry guidelines for sizing heating and cooling equipment and ductwork.

The National Association for Technician Excellence (<http://www.natex.org>) certifies HVAC technicians.

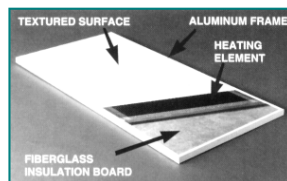
Supplemental Heating and Cooling

Heating:

- Radiant floor heating
- Radiant ceiling panel
- Heat lamps

Cooling:

- Add supply duct
- Enlarge existing duct
- Repair existing ductwork to improve flows



Radiant ceiling panel from Enerjoy, Inc.



Key Concepts

Space heating for a bathroom

Explanation

Bathrooms are often a place where extra heat is desired. Rather than changing the entire mechanical system serving the bath, it is often desirable to supply supplemental space heating for this room. Although supplemental space heating is often electric resistance heating, and electric resistance heating is not known for its high efficiency, it can be a suitable alternative for a relatively small space with intermittent use. Bathroom supplemental space heating is efficient in that it is usually used only when and where it is needed. So, it can be a better alternative than, for example, turning up the whole-house thermostat to make the bath comfortable. There are electric options for radiant floor heating that are relatively easy to install if the floor is being replaced which can be operated via switch or timer. Radiant ceiling panels pictured in the slide are also a relatively simple option. Conventional heat lamps are another option.

Although it is not usually feasible to provide supplemental cooling to a bathroom only, it may be advisable to run bathroom exhaust fans to facilitate circulation and bring in cooler air from other areas of the home. Alternately, if possible, ducts supplying the room could be enlarged or another supply duct could be added. If windows will be installed or replaced, an operable window could help cool the bathroom in some seasons.

Action Items

Consider supplemental heat for a bathroom if homeowner has comfort issues beyond those that can be resolved with upgraded windows and insulation. Consider supplemental cooling if space is largely expanded or comfort issues exist.

Resources

Bathroom Remodeling Lighting

- Task lighting
 - Diffuse around vanity
- Ambient lighting
- Accent lighting



Photo: Brothers Strong, Houston, TX



Key Concepts

Lighting design for bathrooms

Explanation

Plan lighting design carefully to provide adequate, but not excessive, artificial lighting. Use natural lighting when possible to satisfy ambient lighting needs. Providing lighting where it is needed and making use of natural lighting can help reduce lighting energy use in bathrooms.

Three types of lighting in bathrooms include task lighting, ambient lighting, and accent lighting. For a vanity, reducing shadows is a primary consideration; task lighting is optimally supplied by diffuse lighting around the vanity. In showers, a task light overhead can be supplied by a moisture-rated light or combination fan/light. Ambient lighting is often supplied by overhead fixtures or wall sconces. To avoid the energy loss associated with recessed lights, use insulated-contact (IC) rated recessed fixtures or place recessed lights in a soffit below the insulated ceiling. Accent lighting is not typically required in bathrooms.

There are also numerous attractive fluorescent fixtures available and the options are continually increasing.

Action Items

Provide lighting for specific purposes in bathrooms to avoid over lighting in the room.

Provide diffuse light on both sides of a vanity, e.g., fluorescent sconces.

Select Energy Star labeled lighting fixtures.

Resources

ENERGY STAR program labels light fixtures. Find a directory under "products" at <http://www.energystar.gov>

Bathroom Remodeling Lighting

For lighting efficiency, consider:

- Fluorescent fixtures
- Daylighting
- Dimmers

Special considerations:

- Recessed lighting



Key Concepts

Lighting options for bathrooms

Explanation

There are options for improving the energy efficiency of lighting in bathrooms. Good design is of utmost importance to ensure customer satisfaction with lighting in the remodeled bathroom. Many lighting supply stores will provide lighting design services for free. But, make sure they explore the natural lighting options as well as those options that sell product.

Daylighting. Consider window placement and adequacy. For better bath lighting, windows or skylights can be installed. However, windows and skylights typically add to heating and cooling loads. Tubular skylights are a good option for bringing in natural light with minimal energy penalty. Keep in mind that south-facing roof slopes will receive more direct sunlight than north-facing slopes, so consider whether the additional solar gain might contribute to overheating.

There are increasingly better options for fluorescent lighting. Select lamps with a high Color Rendering Index (over 80 on a scale of 0 to 100) and a color temperature around 2800K (which provides a warm light rather than the cool blue light that many associate with fluorescent lighting). The lighting supply store should be able to help you select the right lamps. Although much reduced from the early fluorescent fixtures, some fluorescent lamps still do have a slight buzz or hum. Be sure to ask the supplier how to distinguish or look at a floor sample.

Dimmers can reduce the lighting energy consumption in bathrooms. Dimmers are also a nice feature in bathrooms for mood lighting and for middle-of-the night or groggy-morning lighting needs. Dimmable fluorescent lighting is still difficult to find and can be expensive.

Recessed lighting can be a source of air leakage. Especially in insulated ceilings, select airtight, IC-rated fixtures.

Action Items

Take advantage of natural lighting where appropriate.

When adding or replacing windows or skylights, select those with the ENERGY STAR label. Consider tubular skylights instead of traditional ones.

Use fluorescent fixtures (fixtures that only accept fluorescent bulbs) with high color rendering indices and warm light color temperature.

Install dimmer switches on incandescent lighting fixtures.

Resources

<http://www.buylighting.com> – Commercial website that lists color temperature and CRI for most

Bathroom Remodeling Ventilation Fans

- Use controls that simplify fan use
- Install ENERGY STAR-labeled fans
- Use recommended levels of ventilation



Panasonic



Fantech Inline fan



Key Concepts

Moisture and odor control in bathrooms

Explanation

A simple ventilation fan replacement can result in more efficient equipment operation, increased use of the fan, and more effective moisture removal since people often don't use ventilation fans if they are noisy.

Controls such as twist-timers or humidistats can encourage or ensure the use of bathroom ventilation. They also ensure that fans will not be left on inadvertently.

Quiet fans increase the likelihood that fans will be used frequently, since noisy fans may discourage use. ENERGY STAR fans are rated not only for energy efficiency, but also for sound level. Therefore, buying an ENERGY STAR bath fan will ensure that you get a quiet *and* efficient fan. Maximum sound ratings (noise level) for ENERGY STAR fans is 2 sones for fans at or below 130 cfm and 3 sones at and above 140 cfm. Sound ratings are usually listed on the outside of fan boxes.

In some climates, bath fans can be part of a whole house ventilation strategy. See the module on mechanical systems for more detailed information about how to accomplish this.

Types of fans:

Single-Port fans – The standard fan typically used to provide mechanical exhaust from bathrooms is a ceiling- or wall-mounted fan ducted directly to the outside. When mounting the fan, be sure to cut the drywall closely around the housing and caulk or foam around the housing to prevent air leakage. Also, be sure that there is adequate insulation above the housing when they are located in an attic.

Inline fans - Fans are remotely located and connected to the room via ductwork. The benefit is reduced noise, but the fans require more energy to operate to overcome friction in ductwork. They can be used as a multi-port type fan that draws air from multiple points in the house. In-line fans can be part of a whole-house ventilation strategy.

Fan-light combination units can encourage the use of ventilation fans by tying controls to one switch.

Action Items

Make sure ventilation fans vent to the exterior.

When replacing or installing fans, select ENERGY STAR models that are quiet and efficient.

Consider controls for fan operation to ensure fans are operated.

Consider combining light and fan controls so that both ventilation is not optional

Bathroom Remodeling Ventilation System

- Ensure ventilation fans exhaust to exterior
- Use rigid duct whenever possible
- Minimize duct length and turns



Key Concepts

Proper duct work helps the ventilation fan do its job well.

Explanation

Ventilation is important in a bathroom to remove moisture and prevent moisture from entering into wall cavities. Ventilation fans in bathrooms handle a lot of moisture—so it is imperative that they vent outdoors and not simply to an attic.

Rigid ducts are recommended since they are less likely to have excessive bends and kinks which restrict airflow. Short ducts are also recommended since they reduce friction and improve fan effectiveness.

Photo: Electrical contractor typically sets the fan housing and doesn't always pay attention (nor know) the ductwork path!

Action Items


Use insulated duct through unconditioned spaces like attics to avoid condensation inside the duct when the attic is cold.

Keep duct runs as short as possible – especially if insulated flex duct is used – to facilitate airflow through the duct.

Minimum duct diameter should be 4". Increasing duct diameter to 5" or 6" can facilitate air flow but 6" hoods can be difficult to find.

Resources

Home Ventilating and Indoor Air Quality: A Guide to Providing Comfort and Better Living Conditions <http://www.hvi.org/> or HVI's Bathroom Ventilation Guidelines at <http://www.hvi.org/purpose/articles/BathroomVentilationforHVI.htm>




Bathroom Remodeling Ventilation Sizing

HVI Recommended Sizing

≤ 100 sf: 1 cfm per sf
> 100 sf: Toilet – 50 cfm
Shower – 50 cfm
Sink – 50 cfm
Jetted Tub – 100 cfm

IRC Required Sizing

Operable window area = 1½ sf
20 cfm continuous operation
50 cfm intermittent operation



21

Key Concepts

Sizing bath ventilation

Explanation

According to the Home Ventilating Institute recommendations:

1. An 8x10-foot bathroom should have an 80 cfm fan (at 1 cfm per s.f.)
2. In a 125 sf bathroom with a toilet, shower, and sink, 150 cfm capacity fan should be provided. If a jetted tub is added, the fan size should be increased to 250 cfm.

250 cfm is probably excessive in most cases since all fixtures are not likely to be used at the same time. But the above shows the range of code-required to professional organization-recommended ventilation levels. If fans larger than about 125 cfm are installed, it is advisable to install variable speed fans with multi-speed controls unless this is part of a whole house mechanical ventilation strategy.

Action Items

Consider the above recommendations and requirements when sizing a bath fan.

Resources

Home Ventilating and Indoor Air Quality: A Guide to Providing Comfort and Better Living Conditions <http://www.hvi.org/> or HVI's Bathroom Ventilation

Bathroom Remodeling Ventilation Controls

- Manual on/off controls
- Timers
 - Twist-type manual
 - Automatic (time delay)
- Speed control
- Humidity sensor
- Occupancy sensor



Photos: Energy Federation Inc.



Key Concepts

Types of controls for bath ventilation fans

Explanation

Using controllers such as timers or humidity sensors will help increase the likelihood that fans are operated long enough to remove residual moisture after showering. Automatic controls such as humidistats may be a good choice since they eliminate the reliance on the homeowner for operation.

Cost of Typical Controls:

Manual on/off switches (<\$1)

Manual timer (\$18)

Automatic timer (delay switch) \$30-\$40

Programmable timer \$30-\$65

Fan speed control (for use with variable speed inline fans) \$20-\$60

Humidistat (such as Tamarack Humitrak \$170)

Motion Sensor \$50

Action Items

Install automatic controls that ensure that ventilation fans are operated long enough to remove odor and moisture from bathrooms.

Resources

Fan manufacturers

Retail stores for controls such as electrical supply stores, Energy Federation Incorporated (<http://www.efi.org>)

ENERGY STAR <http://www.energystar.gov>

Rehab Advisor

rehabadvisor.pathnet.org

23

Key Concepts:

Example of a software tool that offers suggestions about energy efficiency improvements for remodeling projects.

Explanation:

The Rehab Advisor is a free and user-friendly software tool that recommends cost effective efficiency measures for typical renovation projects. The basic inputs include building type, location, year of construction, and type of project. Outputs include prioritized energy efficiency measures and payback.

Action Items:

Resources:

rehabadvisor.pathnet.org

Instructor’s Note

Try to demonstrate these software tools “live” in order to give students the opportunity to make inputs and see the results.

Rehab Advisor

The screenshot shows the Rehab Advisor website interface. The left sidebar lists categories: Kitchen, Bathroom (selected), Wiring, Plumbing, Heating and Air Conditioning, Windows, Wall, Floor, and Exterior Facelift. The main content area displays a table of energy-saving measures with columns for Measure, Added Cost, Savings, Payback, and Benefits. Below the table are links for 'Rehab Calculator', 'Web Links', and 'Glossary'.

MEASURE	ADDED COST	SAVINGS	PAYBACK	BENEFITS
Seal Air Leaks - Have a professional seal your home's air leaks. Typically, this reduces air leakage by 25%.	\$500	380 \$/yr	1.3 years	Energy Star, GreenSource
Insulate Walls - Insulate all exterior walls to R-11.	\$28	10 \$/yr	2.9 years	Energy Star, GreenSource
Insulate Floors - Insulate floors above unconditioned spaces to R-19.	\$35	5 \$/yr	6.8 years	Energy Star, GreenSource
Compact Fluorescent Lighting - CFL bulbs use 66% less energy and last up to ten times as long as incandescent bulbs.				Energy Star, GreenSource
Lighting Fixtures - Replace your standard lighting fixtures with ENERGY STAR qualified models.				Energy Star, GreenSource
Low Flow Fixtures - Energy and money aren't the only thing you can save when remodel your bathroom. When installing new shower heads, faucets or a new toilet, consider choosing low flow models to save a significant amount of water too.				Energy Star, GreenSource
Faucets - Low flow faucets use 40% less water than conventional faucets, or about 2.5 gallons per minute compared to 4.				Energy Star, GreenSource



Key Concepts:

Explanation: This is an example of recommended energy improvements for a bath remodeling project with estimated installed costs, savings, and payback. Of course, these estimates may require adjustment to better fit your particular situation. It does provide a relative assessment of various measures.

Other specific project types include a kitchen remodel, room addition, and HVAC system.

Action Items

Resources



For More Information



- ENERGY STAR offers tips for bathroom remodeling at http://www.energystar.gov/index.cfm?c=home_solutions.hm_improvement_bathroom
- The Energy Efficient Rehab Advisor (HUD) offers suggestions by climate, year of construction, and type of project - <http://rehabadvisor.pathnet.org/>



25

Key Concepts

Explanation

Action Items

Resources

ENERGY STAR offers tips for bathroom remodeling at http://www.energystar.gov/index.cfm?c=remodeling.hm_improvement_bathroom

The Energy Efficient Rehab Advisor (HUD) offers suggestions by climate, year of construction, and type of project - <http://rehabadvisor.pathnet.org/>

Fact sheets: <http://www.eere.energy.gov/consumerinfo>

ToolBase Services: <http://www.toolbase.org>

Virginia Energy Savers Handbook (Energy Use in Your Home) http://www.mme.state.va.us/de/handbook_one.html