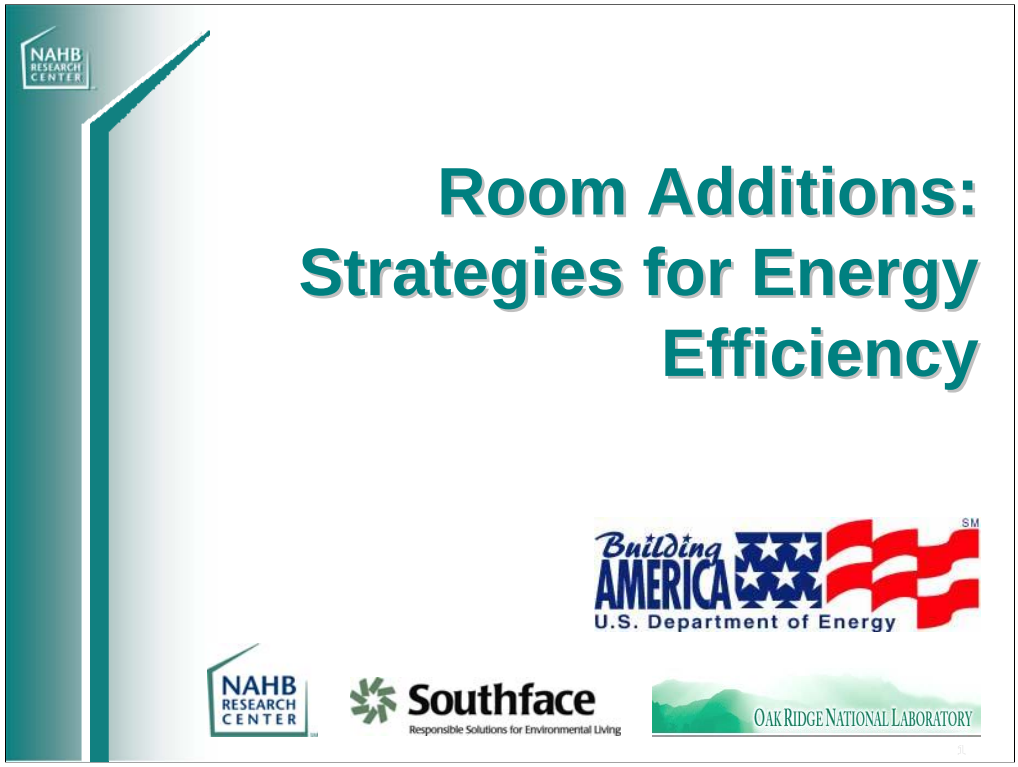


Key Concepts

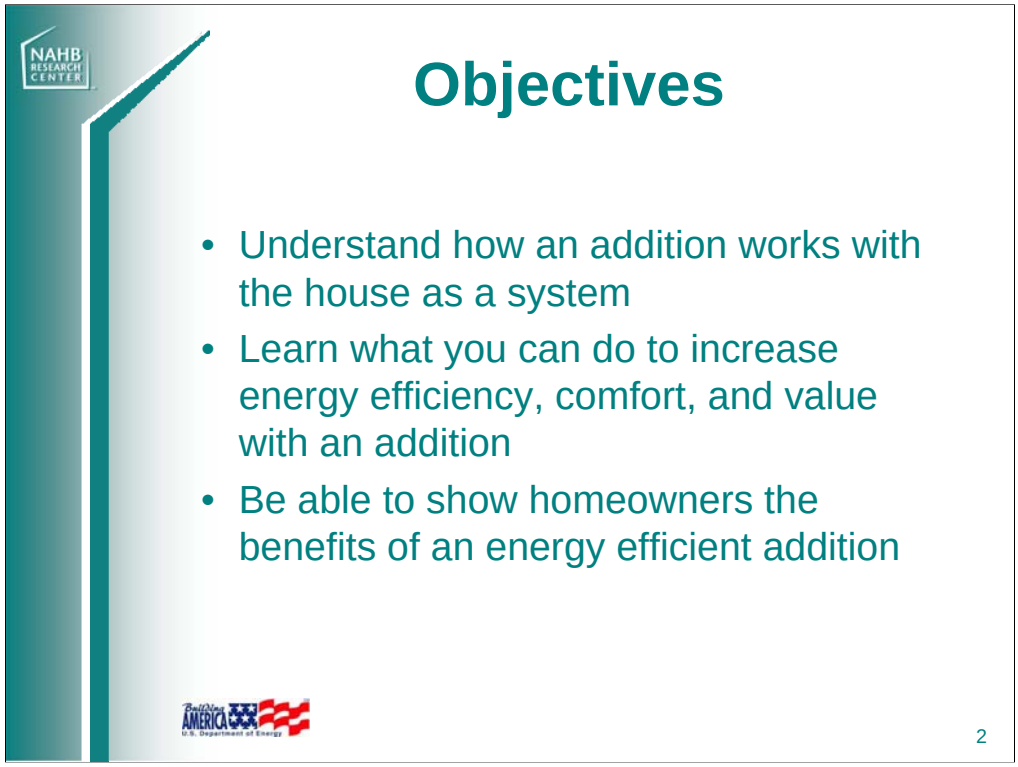
This module will cover key concepts and practices essential to achieving energy efficiency in room additions and will show how these additions can have a positive impact on the remainder of the house as well.

Explanation

After completing this module, you will be able to understand the key issues of an energy efficient room addition and explain the concepts to customers.

Action Items

Resources



Key Concepts

Objectives of this module

Explanation

An addition becomes part of the house, and therefore must be planned to become part of the house system. When planning an addition, it is important to consider the addition as part of the whole house system, and to evaluate ways to maintain or improve overall house performance with the addition. For example, the capacity of a heating system may, at first glance, seem inadequate to serve the addition. However, by using efficient materials, techniques, and smart design, the addition may be able to be served by the existing heating system.

Action Items

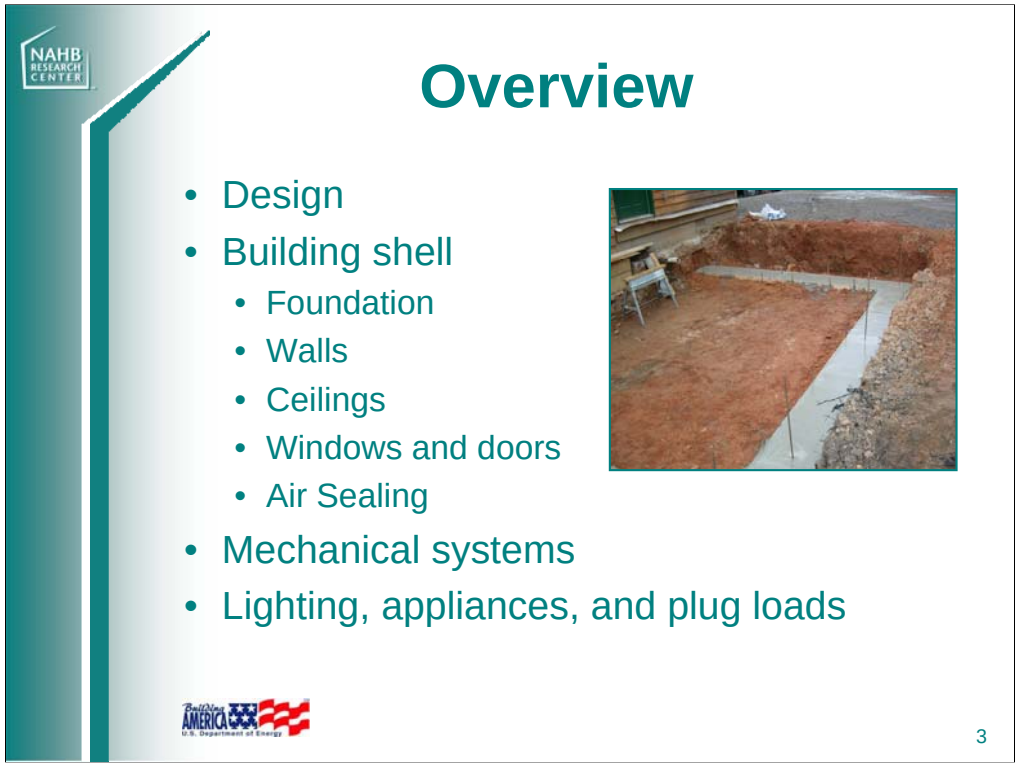
Use tools provided through this course along with your team of subcontractors to plan an addition that will have a neutral or beneficial effect on overall house performance. This approach helps to avoid callbacks and create happy customers who will refer you to their friends and neighbors.

Resources

No Regrets Remodeling (book); **Paperback:** 222 pages; **ISBN:** 0963944428 (November 1997), Home Energy Magazine. This book shows how to look at the house as a system and how to enhance a home's performance and comfort through energy efficiency measures.

Building America www.buildingamerica.gov

Home Energy Magazine article on additions: http://homeenergy.org/archive/hem.dis.anl.gov/eehem/96/960108.html



Key Concepts

Parts of an addition that affect overall performance

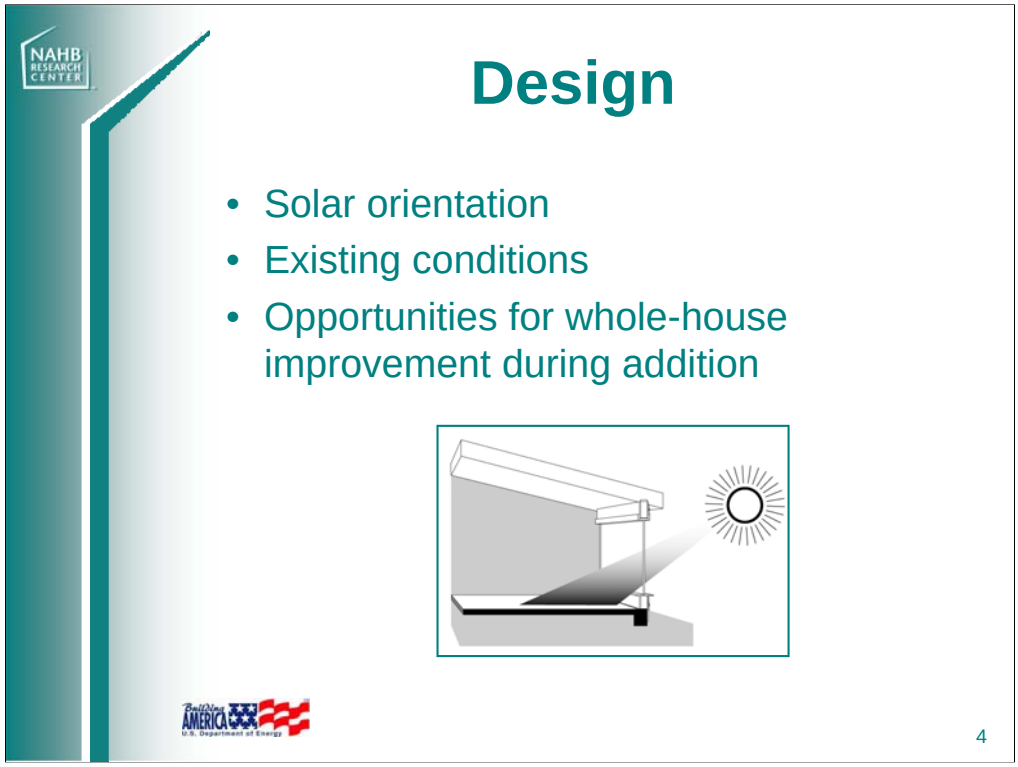
Explanation

An addition is made up of the building shell—foundation, walls, ceilings, windows, doors, and air sealing measures, the mechanical systems to condition indoor air and heat water, and lights, appliances, and "plug" loads. The materials and techniques employed in any job will depend on the client's desires, the climate, existing codes and standards, and locally available materials. However, for any job, the selection of systems for an addition can be balanced between the cost of efficiency upgrades and the benefit received. Each part of the system will be discussed in detail in this module.

Action Items

Know the parts of an addition and their interaction in the house system.

Resources



Key Concepts

Site conditions and design aspects that affect energy efficiency.

Explanation

There are certain features beyond materials and equipment that affect the energy efficiency of an addition. One features is the relationship of the addition to the sun. The diagram shows that solar heat gain through a window can be absorbed by a concrete slab floor and released slowly. However, solar heat gain can be detrimental. For example, in a moderate climate, an addition that includes abundant windows on the east and west walls may experience frequent overheating of the space. Furthermore, homeowners may feel uncomfortable during the colder months at nighttime due to radiant heat transfer between the person and the cold window surface. Alternately, south-facing glass can offer solar heating in the winter and, with properly sized overhangs, will not contribute to overheating in the summer.

Energy efficiency starts with design. Consider the existing site and try to work with the homeowner on designing for efficiency. Use overhangs above south-facing windows to provide summertime shading while allowing the sun to warm the space when it is low in the sky in wintertime. In most climates, try to minimize east and west facing windows, which often contribute to unwanted heat gain. Use operable windows to take advantage of natural breezes. Note existing trees: deciduous trees can provide summer shading but allow much of the winter sun through; evergreen or coniferous trees can provide shade and wind breaks year-round.

The design phase is also an excellent time to consider whole-house efficiency upgrades such as window replacement or adding insulation to the existing portion of the house.

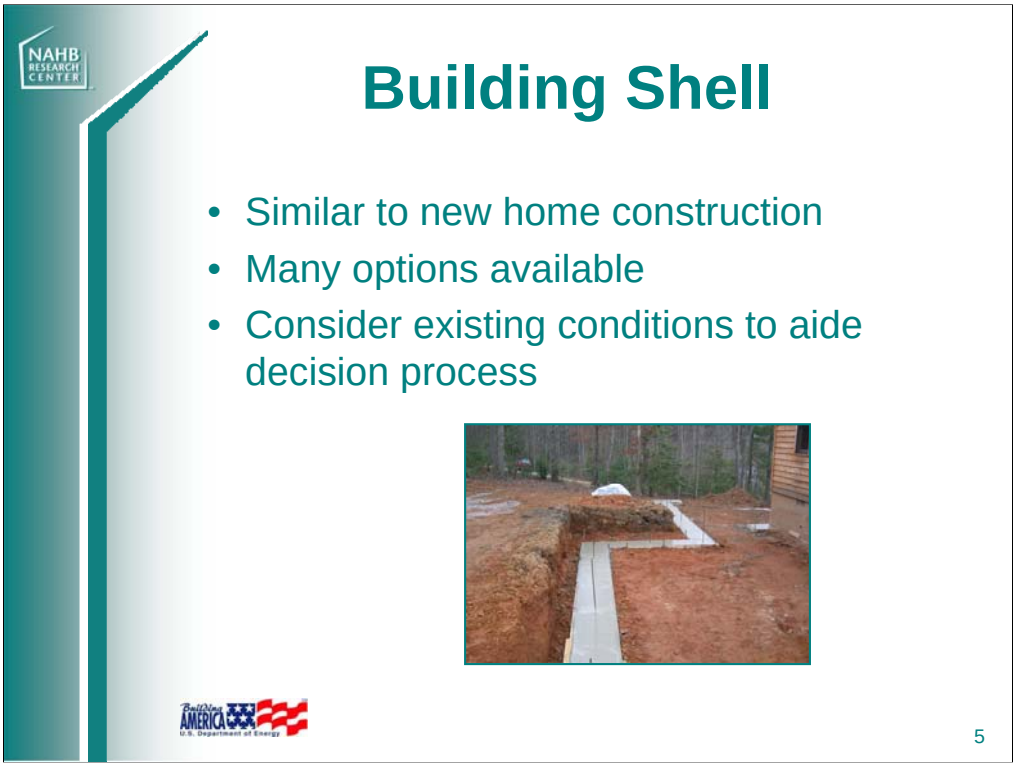
Action Items

When looking at a job, if you will be involved in the design phase, take note of existing conditions and how the site and addition design might affect the energy efficiency of the new space.

Consider how other improvements might be made to the whole house while the construction is ongoing.

Resources

Passive Solar Design Fact Sheet,
http://www.toolbase.org/docs/MainNav/Energy/3944_passivesolardesign.pdf



Key Concepts

Building shell

Explanation

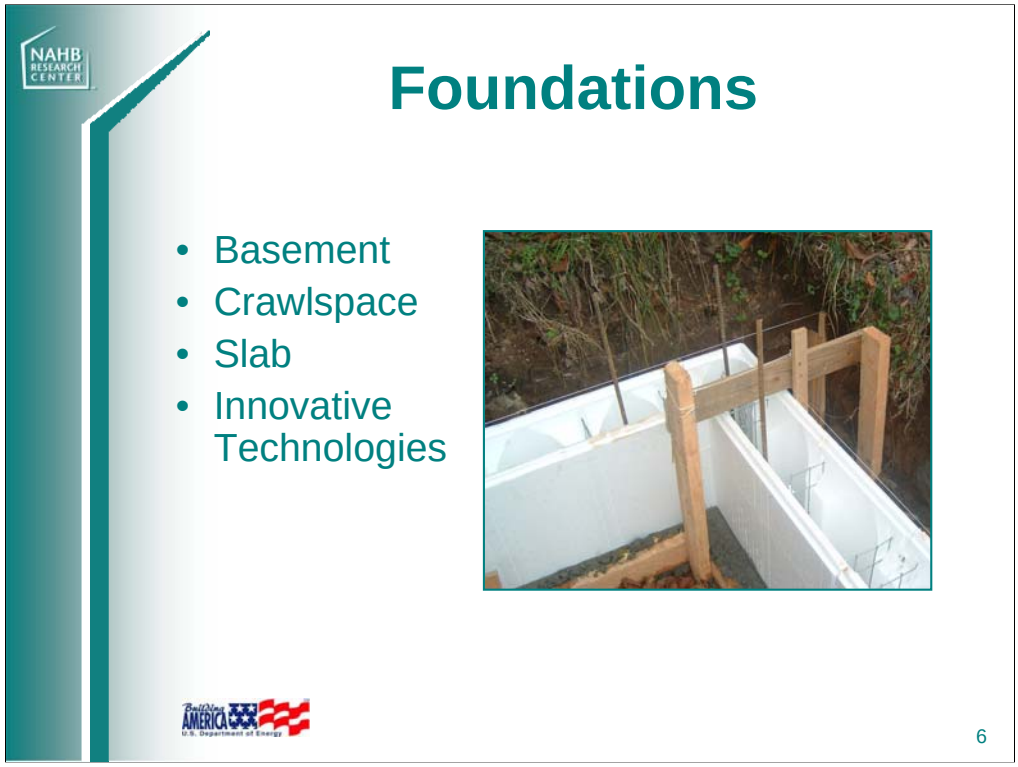
The purpose of an energy efficient building shell is to provide protection from the elements while maintaining a connection to the outdoors. An energy efficient building shell will consist of a climate-appropriate level (R-value) of insulation in the wall, roof, and foundation system, climate-appropriate windows and doors, and an air sealing package to reduce uncontrolled air infiltration. Next, we will discuss some of the materials and systems common in an energy efficient building shell.

Action Items

Learn about the materials available in your area for building an efficient home and the cost of the various systems.

Resources

ToolBase Website, www.toolbase.org. Includes a “technology inventory” with the latest technologies for home building.



Key Concepts

Systems available for foundations

Explanation

Photo shows first course of an insulated concrete form being ‘wet set’ into the just-poured footing.

Any foundation can be designed and built for energy efficiency, whether it is slab, crawlspace, or basement.

Basements: If basements will contain living space or mechanical equipment, insulating the space is a good idea in almost all climates. Rigid foam can be used with concrete block or poured concrete foundations on the interior or exterior walls. Although initially more expensive than other insulation types, rigid foam has the advantage of being resistant to below-grade moisture.

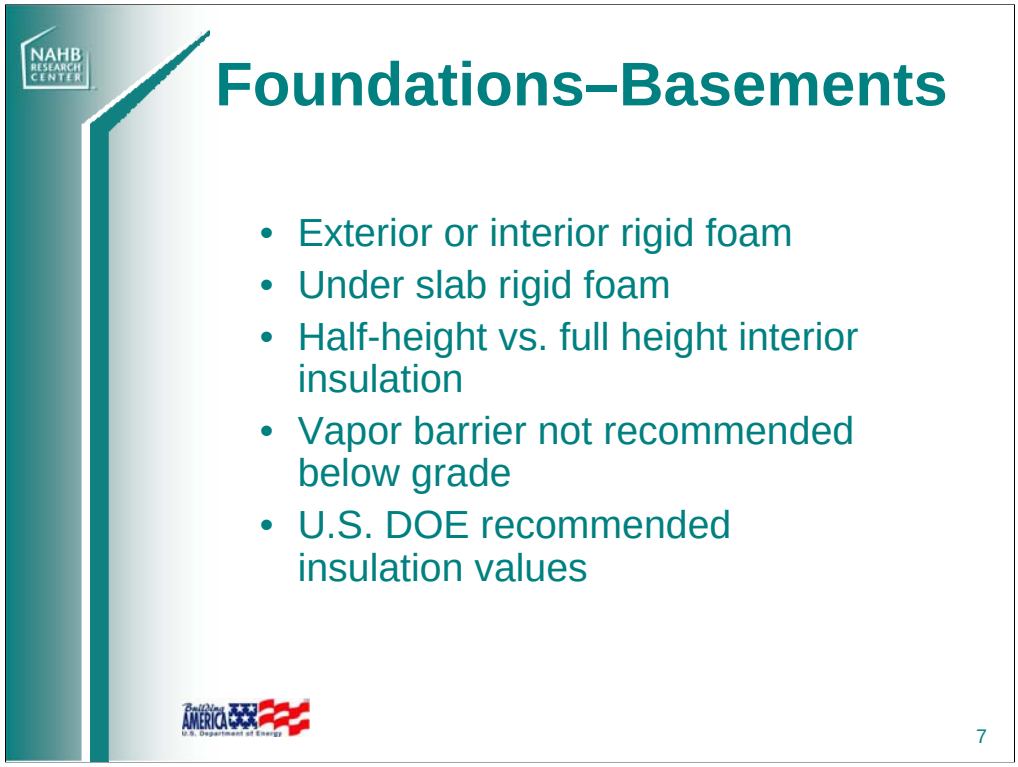
Crawlspace: Especially in warm humid climates or when mechanical equipment and ductwork is located in crawlspaces, it is more energy efficient to insulate the crawlspace walls, provide a vapor barrier over the dirt floor, and keep the crawlspace unvented year-round.

Slabs: There can be significant heat loss through the slab foundation—particularly at the slab edge which is exposed to the outdoors if uninsulated. Even in warm climates, it often is cost effective to add slab edge insulation. In colder climates, more sophisticated methods are needed, such as frost-protected shallow foundations or stemwalls with footings below the frostline.

Several other systems are available for creating an energy efficient crawlspace or basement foundation, including: insulating concrete forms, precast concrete wall panels, and permanent wood foundations.

Action Items

Resources



Key Concepts

Improving foundation wall energy efficiency

Explanation

Even though basements are below grade, it can often make sense to build a foundation for efficiency—especially if the basement will be part of the conditioned space (now or in the future) or if ductwork and mechanical equipment is located in the basement.

When building a new foundation, insulating foam can be used on the exterior unless prohibited by code (e.g., in areas where termites bore through the foam). This practice helps reduce potential moisture issues (less condensation potential on warm wall surface) and is relatively simple to do when building a new foundation.

Rigid foam (interior or exterior) is a good material for below-grade applications because of its moisture resistance. In very cold climates, it can be used underneath the entire basement slab for efficiency.

The U.S. Department of Energy (DOE) offers recommendations for basement wall R-value, searchable by zip code (see Resources).

Action Items

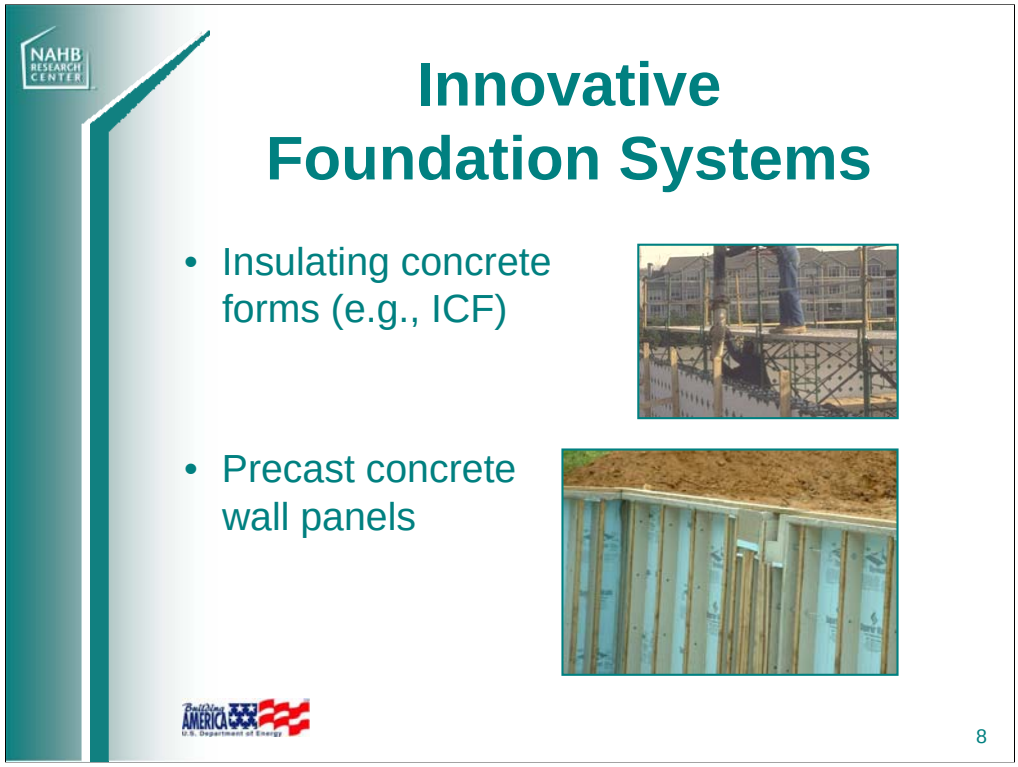
Resources

EEBA Builder Practices Guides, available at http://www.eeba.org

Building America's Houses that Work Climate Specific Best Practices. Includes section drawings for basements in cold and mixed climates.
http://www.buildingscience.com/housesthatwork/default.htm

DOE's recommended insulation values,
http://www.ornl.gov/sci/roofs+walls/insulation/ins_16.html

Basement Insulation Systems, by Building Science Corporation,
http://www.buildingscience.com/resources/foundations/basement_insulation_systems.pdf



Key Concepts

Innovative systems for creating basement foundations

Upper photo: Pouring concrete in insulated concrete forms stacked and braced

Lower photo: Superior Wall system of precast and insulated foundation walls

Explanation

There are systems designed to simplify the task of creating a well-insulated foundation. These systems typically cost more for labor or materials, but may save on combined materials and labor costs.

For example, ICFs (pictured here) are concrete forms made from insulating rigid foam which stays in place after the pour. Precast concrete wall panels, such as Superior Walls, are trucked to the site and put into place by crane. Individual panels are connected together to form basement walls. In the case of Superior Walls, the panels come with interior rigid foam insulation and imbedded wood for attaching interior finishes.

Action Items

Consider using systems that can ease the process of creating an energy efficient basement foundation system, especially when ductwork, mechanical equipment, and living areas will be located below grade.

Resources

Insulating Concrete Form Association, http://www.forms.org

Superior Walls, http://www.superiorwalls.com

Key Concepts

Alternative foundation construction methods: frost protected shallow foundations

Explanation

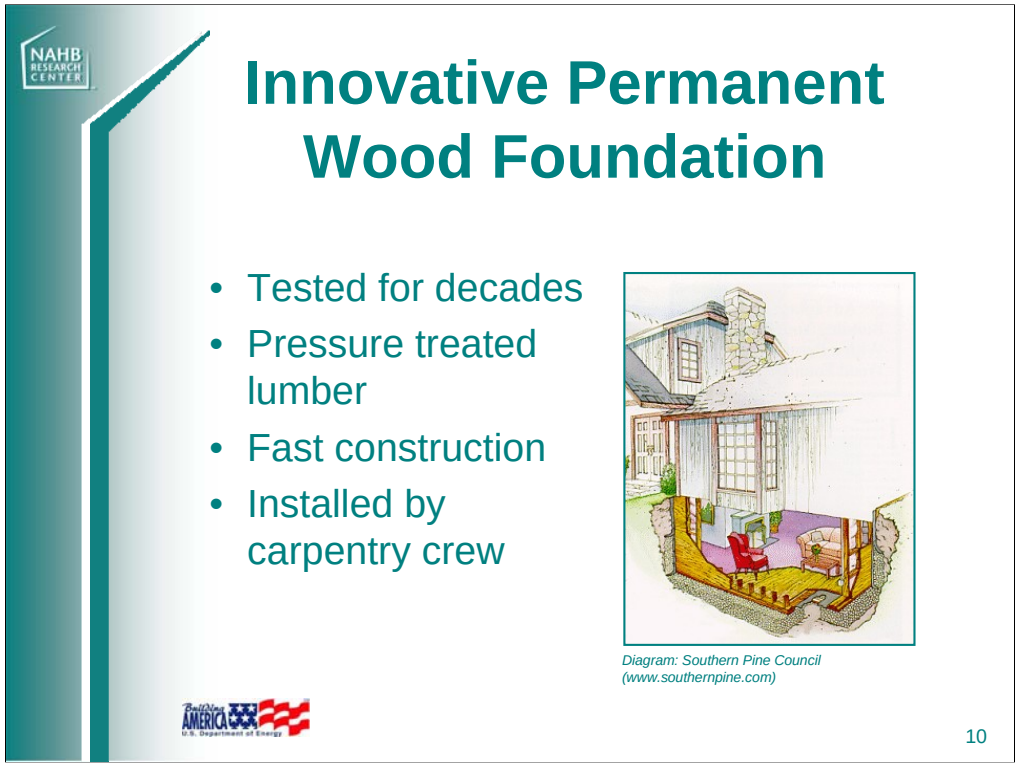
A frost protected shallow foundation (FPSF) is a practical alternative to a deeper, more-costly foundation in cold regions with seasonal ground freezing and the potential for frost heave. The International Residential Code® (IRC) includes prescriptive methods for constructing frost protected shallow foundations in heated buildings.

Action Items

Consider a FPSF for providing an energy-efficient and economical foundation alternative.

Resources

Revised Builder's Guide to Frost Protected Shallow Foundations, NAHB Research Center, available for free download at http://toolbase.org/docs/SubsystemNav/Foundations/4495_RevisedFPSFGuide.pdf



Key Concepts

Permanent wood foundations (PWFs)

Explanation

Permanent wood foundations are created with pressure-treated lumber. They can simplify foundation construction—PWFs are installed by a carpentry crew in about a day—and ease the process of insulating the basement. PWFs are accepted by the model building codes and home warranty companies.

Action Items

Resources

Southern Pine Council's (http://www.southernpine.com) *Permanent Wood Foundation Design Guide* (free download): http://newstore.southernpine.com/images/ref400.pdf

Key Concepts

Sealed (unvented) crawlspace design

Upper photo: air sealing measures at a common leakage path where mudsill sits on foundation wall.

Lower photo: sealing vapor barrier to foundation pier with white polyurethane caulk.

Explanation

As building science has shown, sealed, conditioned crawlspaces are a practical method for handling crawlspace moisture. Industry experts are specifying this design more frequently, especially as building codes adopt the practice. In humid climates, sealed conditioned spaces limit the likelihood that condensation will form on cool surfaces such as water pipes and ducts, which can lead to mold problems. Condensation and moisture can be a problem during the summer even in moderate and colder climates. Furthermore, in cold climates, it is generally recommended that crawlspace vents be closed during the winter and heat is often provided to the space if piping or ductwork is contained within. Therefore, in many regions, it is advisable to include the crawlspace within the conditioned envelope. See Resources for design details.

The International Energy Conservation Code has provisions for sealed crawlspaces that include a ground cover, R-value requirements for walls, and mechanical ventilation or space conditioning. If HVAC ductwork and equipment will be located in the space, the space should be conditioned.

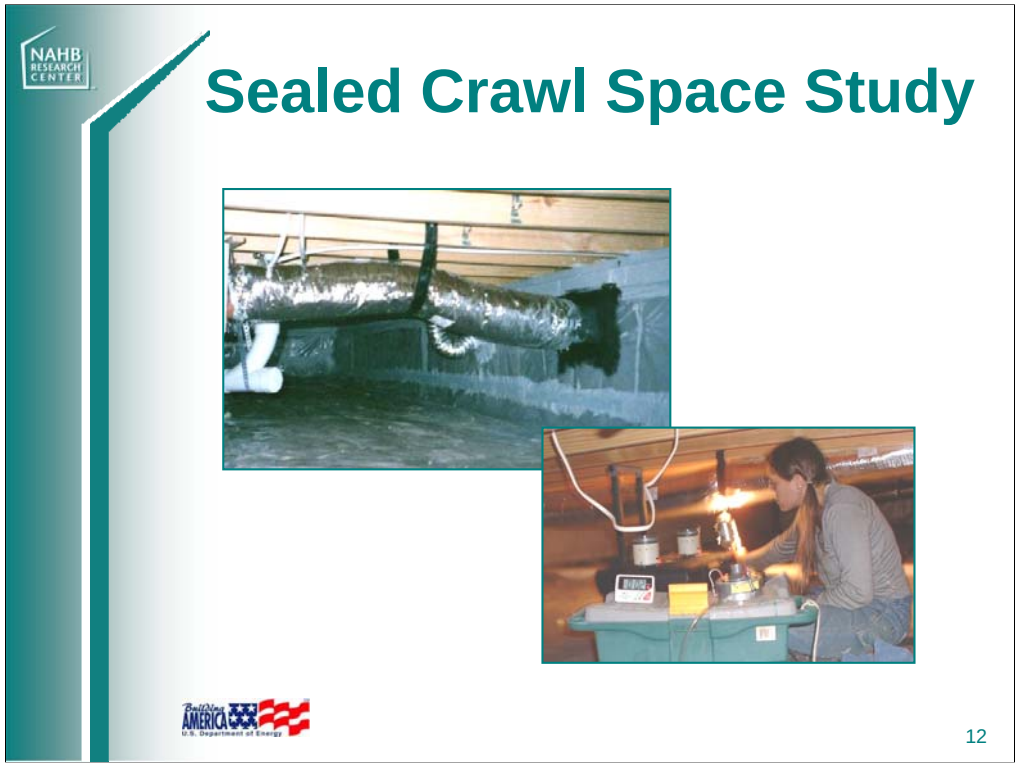
Action Items

Resources

International Energy Conservation Code, available for $29 at www.iccsafe.org

Janesky, Larry, “Sealing a Crawlspace,” *Fine Homebuilding,* v. 153, p. 94-99, http://www.taunton.com/finehomebuilding/pages/h00107.asp

Yost, Nathan, 2004, Crawlspace Design, © Building Science Corporation



Key Concepts

A recent research study has confirmed the efficacy of sealed crawlspaces.

Explanation

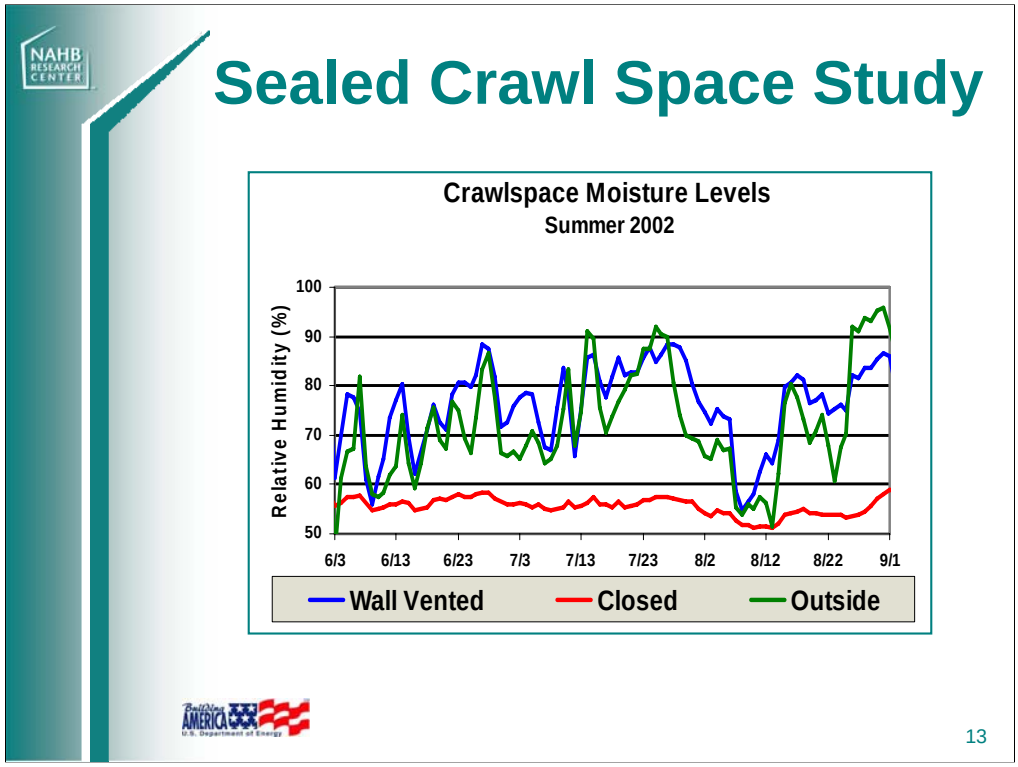
If moisture intrusion is eliminated and no atmospherically vented combustion equipment are present, sealing a crawlspace can improve the comfort, air quality and overall efficiency of a home.

A study recently conducted tracked temperature, relative humidity, the presence of mold and other factors in twelve new Habitat for Humanity homes built in North Carolina. Four of the twelve had crawlspaces with conventionally insulated floors with foundation vents. Eight of twelve were built with sealed crawlspaces. (Four of these had foundation insulation; four had none). The eight homes had either no visible mold or less mold, more comfortable spaces on the main floor, and lower energy bills.

Action Items

Resources

http://www.crawlspaces.org



Key Concepts

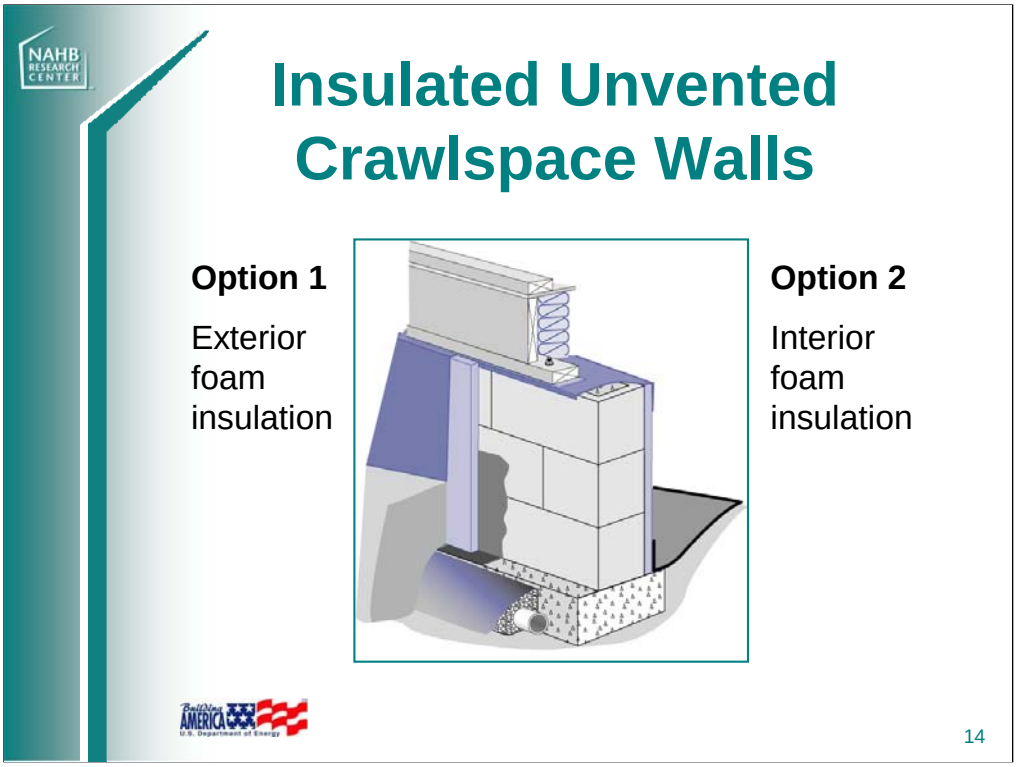
In a Summer 2002 Building America study, sealed crawlspaces maintained consistently lower relative humidity levels compared to vented crawlspaces.

Explanation

By sealing the crawlspace from moist outside air, relative humidity can be stabilized at levels below which mold will grow. By comparison, the relative humidity in vented crawlspaces closely tracked outside humidity, and a good portion of the time were above 70%, the point at which most molds grow.

Action Items

Resources



Key Concepts

Insulating crawlspace walls

Explanation

There are two basic approaches to insulating unvented crawlspace walls - applying insulation on the exterior or interior. In both cases, a vapor retarder, with 100% coverage should be installed on the soil. Installing a foundation drain pipe, embedded in gravel and covered with filter fabric, is also advisable, particularly when interior grades are lower than exterior grades.

Action items

Resources

Sealed Crawlspace: 2000 IRC Section R408.2 Exception 5 “Ventilation openings are not required when the ground surface is covered with an approved vapor retarder material, the space is supplied with conditioned air and the perimeter walls are insulated in accordance with Section N1102.1.7”

Instructor’s Notes

Ask students if they have seen moisture problems in existing crawlspaces. Ask if any have experience with building unvented crawlspaces –especially in humid climates.

Key Concepts

One method of insulating the interior surface of foundation walls is with rigid foam insulation

Explanation

This photo illustrates the installation of expanded polystyrene foam that is treated with boric acid to resist termite activity.

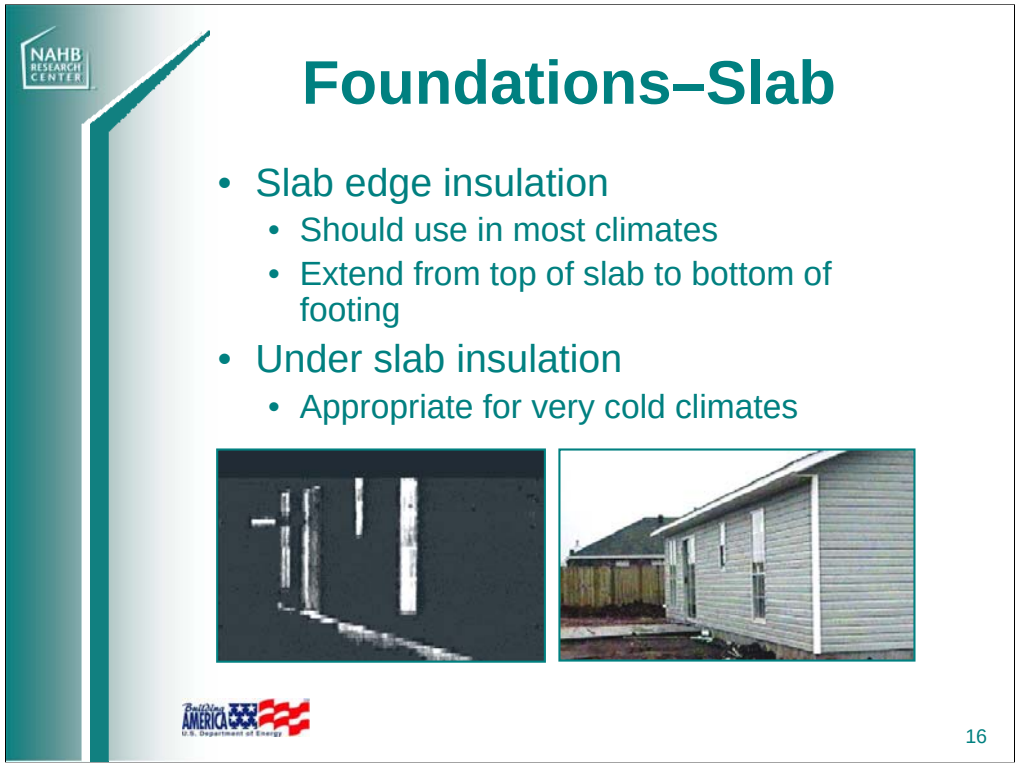
The foam is glued to the block wall and the seams and perimeter are sealed to prevent air movement between the block wall (the air barrier) and the foam (the thermal barrier).

The band joist area can be insulated with a fiberglass batt that is removable for termite inspections.

Action Items

Resources

Southface technical bulletin on crawlspaces.
http://www.southface.org/web/resources&services/publications/technical_bulletins/CI-Crawlspace%2000-774.pdf



Key Concepts

Slab foundations

Photo: room addition in Atlanta without slab edge insulation. Under slab insulation not needed in the southeast.

Explanation

Thermal losses are shown graphically in the thermal image photo above left (daytime photo of same house is at right).

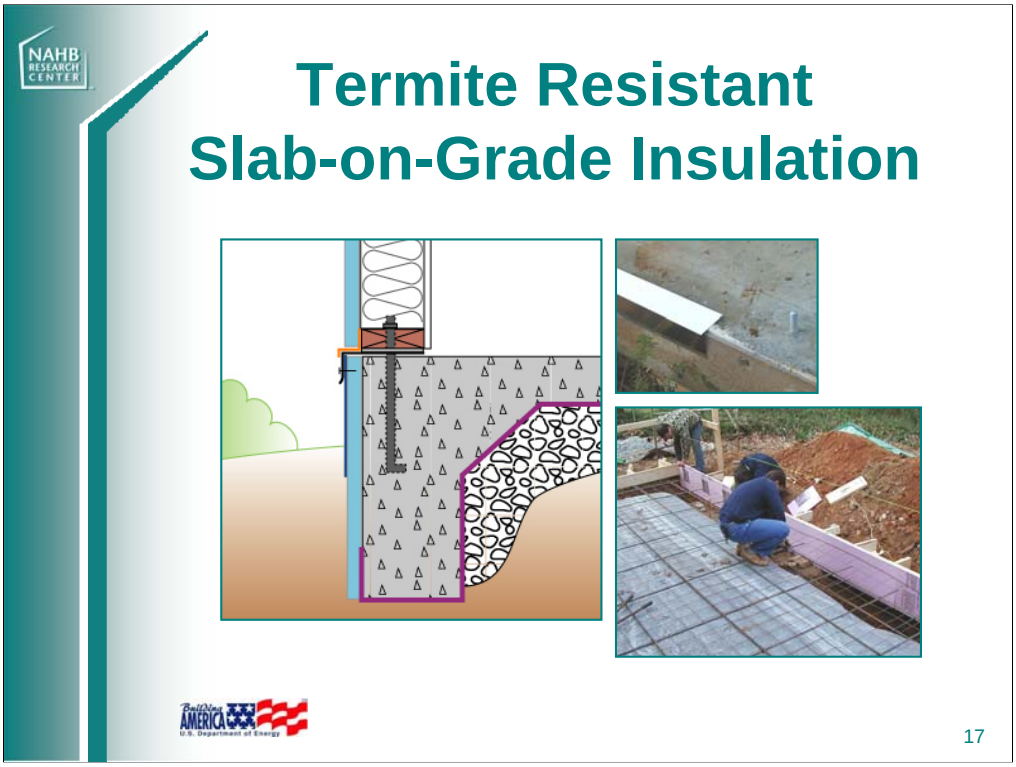
Slab foundations are common in the South, where it is often thought uneconomical to insulate the slab. However, slab edge insulation can save a lot of energy since the slab edge is exposed to the outdoor air and is an area for significant heat loss. Slab edge insulation should extend from the top of the slab edge to the bottom of the footing. In very cold climates, rigid insulation can be placed directly below the entire slab. Insulation can be placed horizontally out from the slab to increase protection from frost heaving. This will not be as effective as subslab insulation in reducing heat loss through the slab.

Besides saving energy, slab edge insulation raises the slab temperature above the condensation point reducing chances for mold growth.

Action Items

Use slab edge insulation for slab foundations in all but the hottest climates.

Resources



Key Concepts

Exterior insulation reduces thermal losses but must be protected due to its fragility.

Explanation

Rigid insulation can be covered above the soil line with fiber cement siding to protect from impact damage as shown in upper right photo. The top edge of the foam can be isolated from the structure with continuous angle flashing to reduce chances for termite activity. In addition, if the flashing is the full width of the bottom plate it also serves as a capillary break, preventing wicking of moisture into the walls.

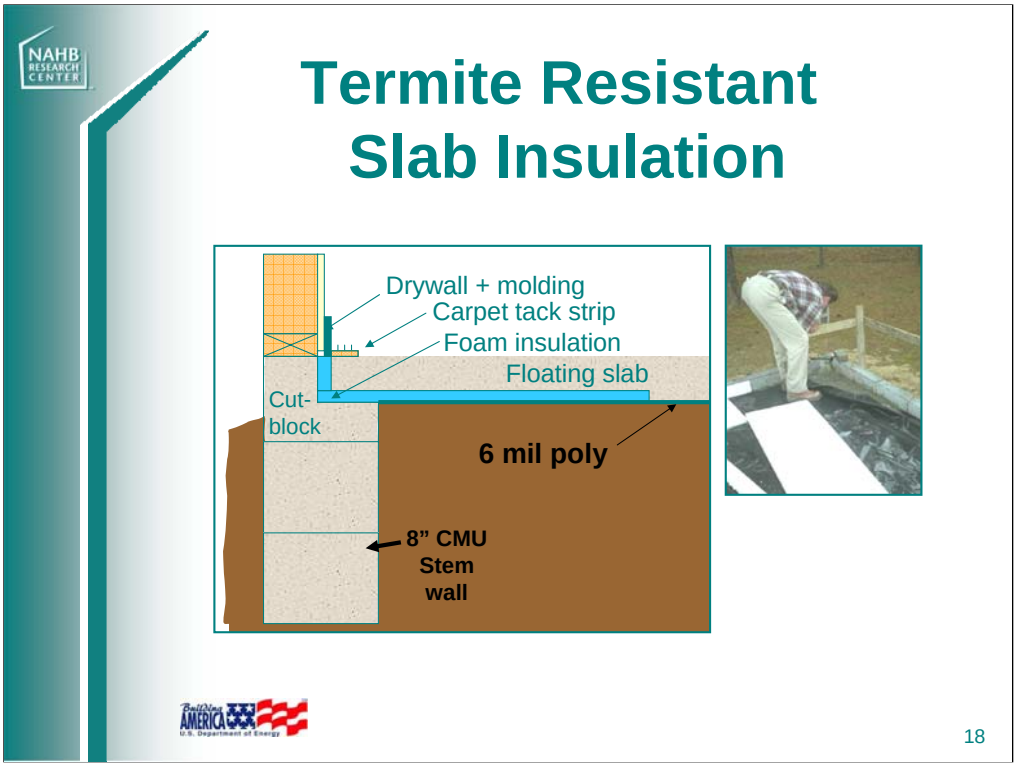
Action Items

Resources

Southface technical bulletin on slab insulation.
http://www.southface.org/web/resources&services/publications/technical_bulletins/SI-Slab%20Insulation%2000-775.pdf

Instructor's Note

Especially in areas of high termite infestation, discuss potential for termites to tunnel behind or through the styrofoam. A physical barrier between the sill and framing is recommended or select a different insulating method.



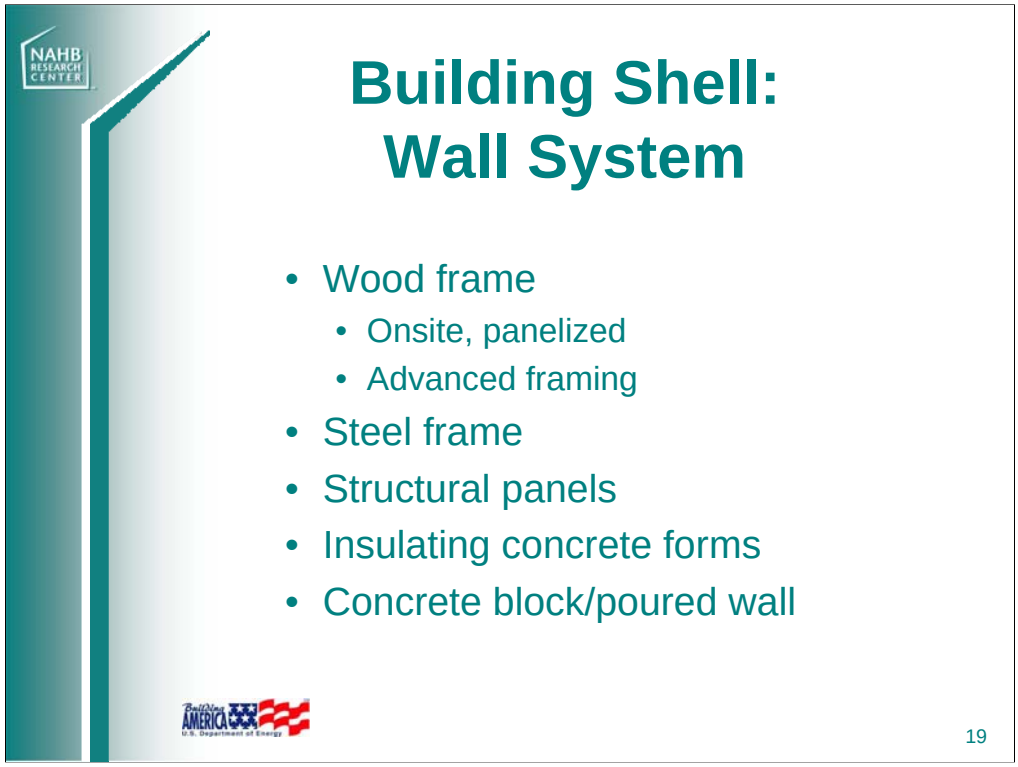
Key Concepts

When installing a slab on a foundation, it is necessary to insulate horizontally to prevent thermal transfer through the foundation wall. An extruded foam board insulation such as the blue or pink board should be used. It not only is more resistant to moisture but is higher density and therefore, can handle the structural loads. Analysis by the NAHB Research Center shows that an extruded polystyrene rigid board insulation (Type V, VI, or VII) can support a 9' brick veneer wall.

Explanation

Action items

Resources



Key Concepts

Wall system options

Explanation

There are numerous options for building walls. Each can be made energy efficient by paying attention to design and construction details. These details are provided in the next few slides.

Action items

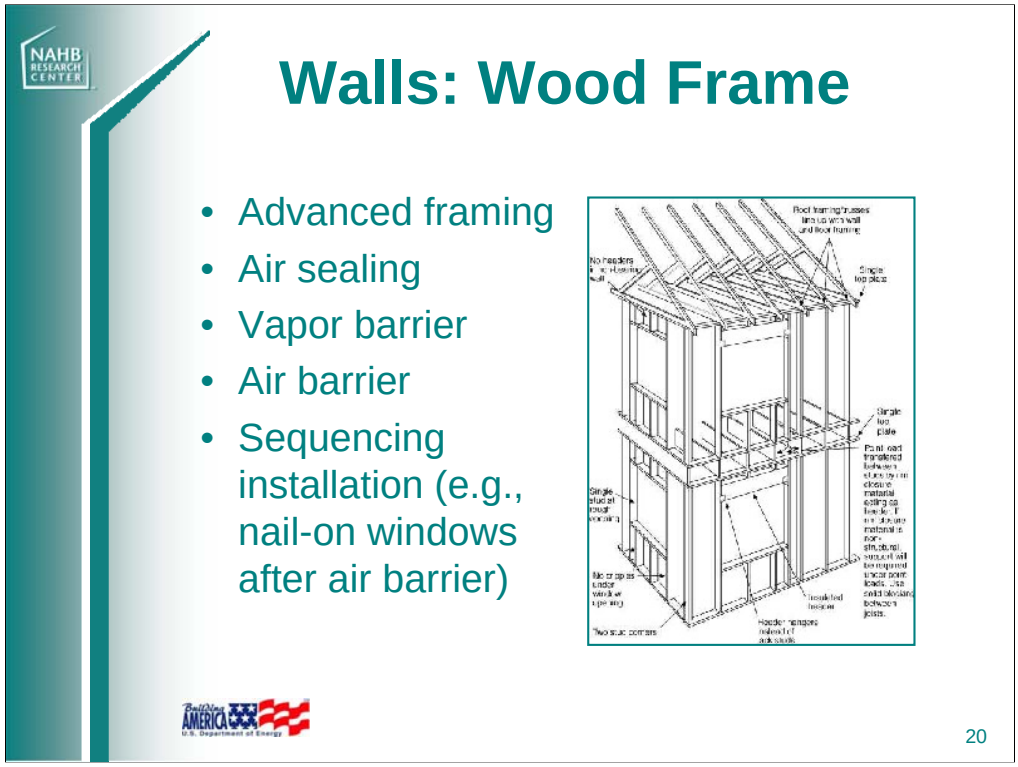
Be aware of some of the options available today for building walls. You may find a system that works for you in energy efficient additions.

Resources

ToolBase Services http://www.toolbase.org

Instructor's Notes

Ask whether any of the students have used alternate structural systems like SIPS or ICFs.



Key Concepts

Energy efficiency with a wood-framed wall

Explanation

A wood framed wall can be built to meet the same energy efficiency standards as a wall using any innovative technology. However, some attention to detail is required. To increase the efficiency of a wood framed wall system, advanced framing (or optimum value engineering [OVE]) techniques can be employed. OVE uses less wood and, hence, more insulation than conventionally framed walls and produces less waste. Examples of OVE techniques include two-stud corners using drywall clips for attachment, ladder-blocking at interior/exterior wall intersections, and in-line framing which permits a single top plate and 24-inch on-center framing. Next, detailed air sealing at top and bottom plates, rim joists, utility penetrations, and around windows will prevent unwanted air infiltration. For cold climates, combining detailed air sealing with an interior vapor barrier will keep interior moisture out of wall cavities. A carefully installed air barrier or housewrap that is taped at the seams and installed prior to windows and doors will help keep exterior moisture and air out of walls. Be sure to follow manufacturer's installation instructions for best performance.

Action Items

Learn about advanced framing techniques that can reduce lumber and waste and create a more energy efficient wall.

Use detailed air sealing measures on each project.

Carefully install air barriers and tape seams.

Resources

Advanced Framing Fact Sheet (U.S. DOE):
http://www.toolbase.org/docs/MainNav/WoodFrameConstruction/3949_advancedwallframing1.pdf

Reduce Framing Costs with Advanced Framing Techniques (EPA):

Key Concepts

Advanced framing techniques save materials costs and allow more insulation in walls than conventionally framed walls.

Explanation

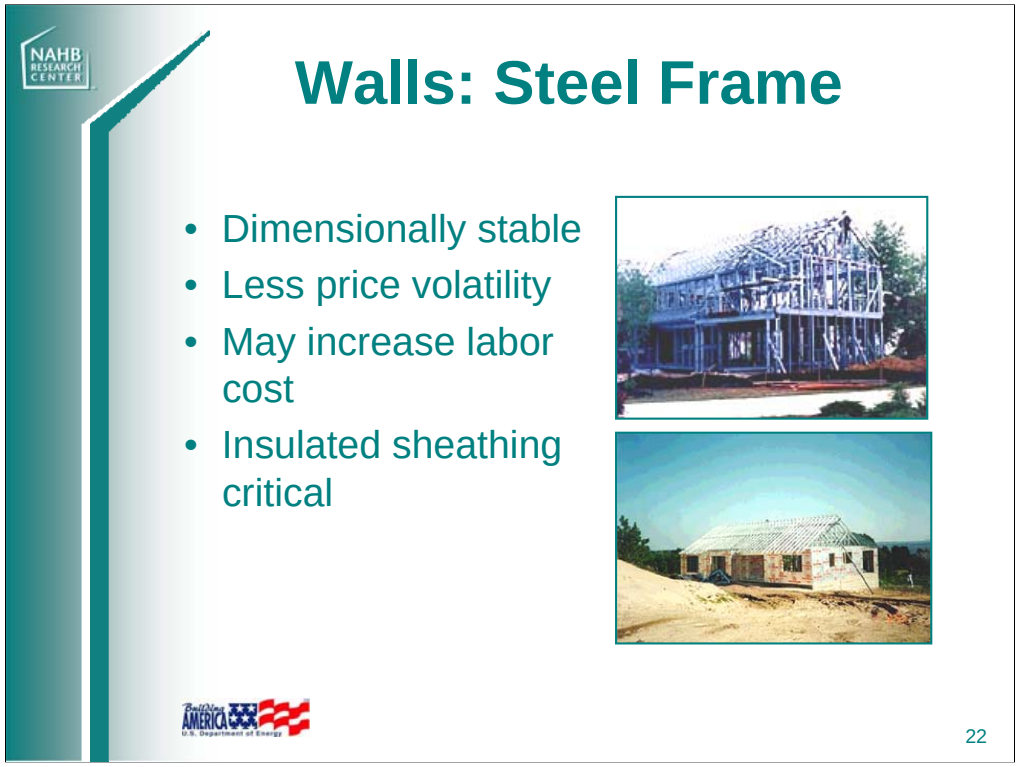
Photo left shows an energy efficient corner tat permits insulation to the edge of the wall.

Photo top right shows energy efficient ladder blocking used for connecting an interior partition wall to an exterior wall (which reduces lumber and permits more insulation at the intersection than conventional partition wall connections).

Photo bottom right shows an insulated header with ½-inch rigid foam between layers of the header.

Action Items

Resources



Key Concepts

Steel framing

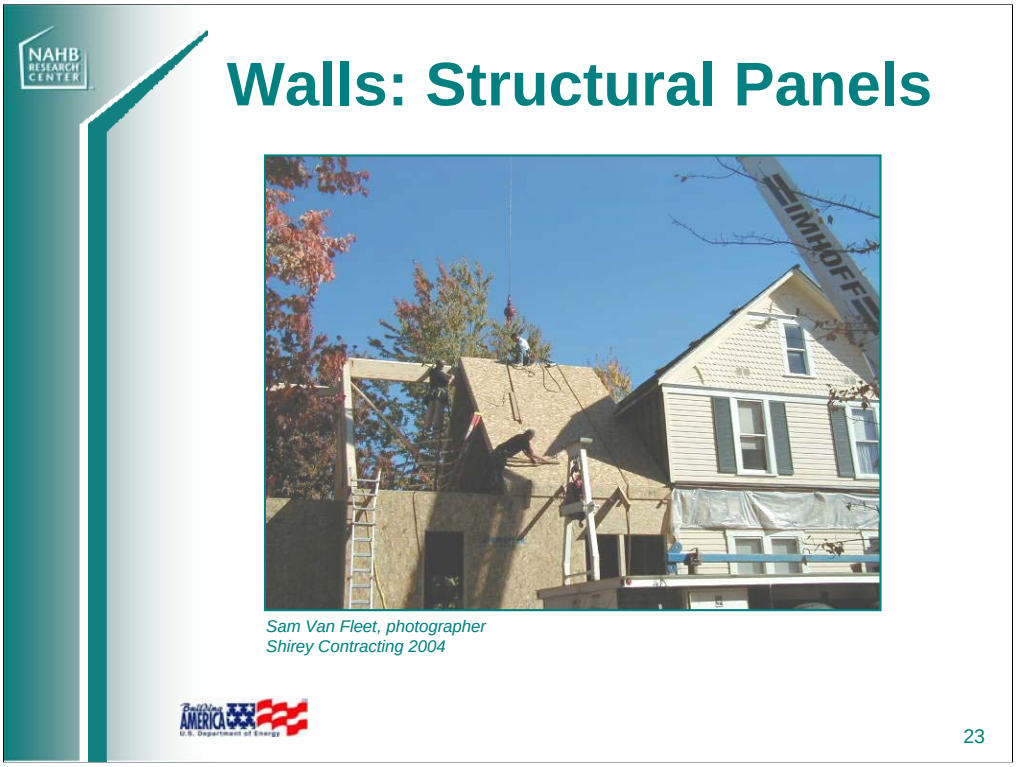
Explanation

Steel framing is becoming increasingly common, in part due to code acceptance of standard methods of design. Steel has the advantage of consistently straight studs and less price volatility than lumber. However, steel has the disadvantage of conducting thermal energy more readily than wood. Therefore, interior or exterior rigid foam or another “thermal break” is recommended when using steel framing. Because rigid foam provides a continuous layer of insulation, it can be more effective than cavity insulation for steel framing when an equivalent R-value is used.

Action Items

Resources

Dietrich Industries website (commercial website that contains a primer on steel framing)
http://www.dietrichindustries.com/studyguide/introtometalframing.asp



Key Concepts

Structural panels can be part of an energy efficient building shell

Explanation

Photo shows structural insulated panel (SIP) addition to an historic house in Washington State.

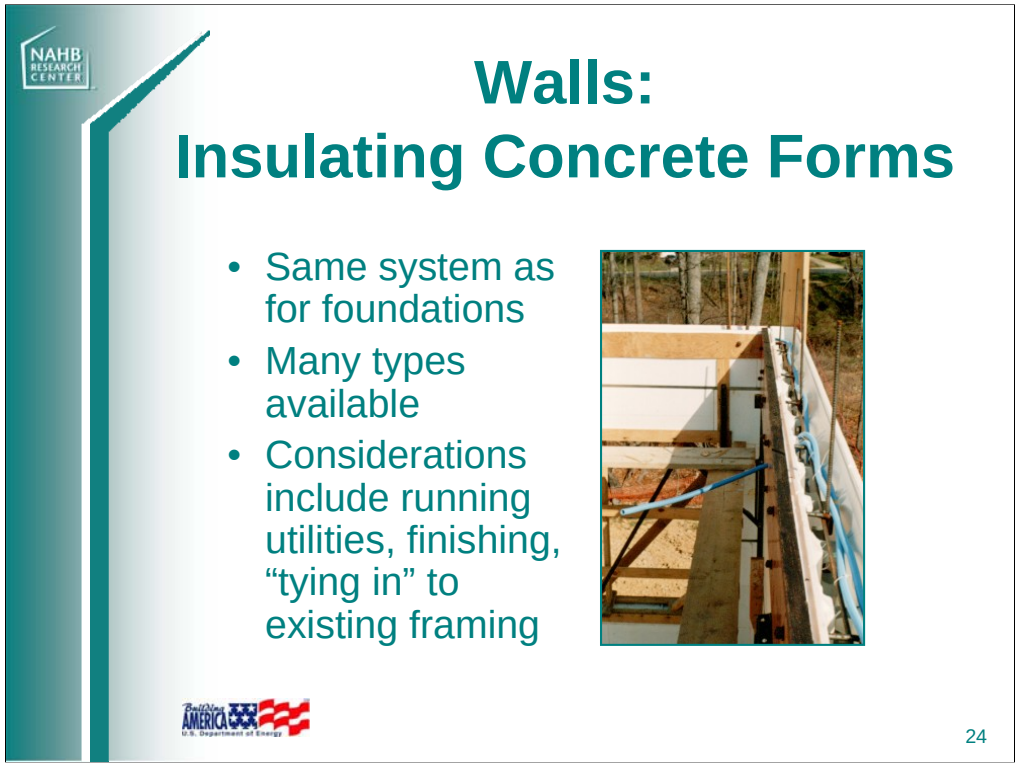
There are structural panels available to create high R-value wall systems such as Structural Insulated Panels and the Techbuilt system. SIPs typically consisted of 4- to 8-inch thick rigid foam insulation between two OSB panels. Window openings are factory cut and panels are shipped to the site and placed by hand or crane. The Techbuilt system employs steel structural members and a foam insulation panel. Keep in mind that careful installation and attention to detailing is as important with a panelized system as with a conventional framed wall. Connections between panels must be tight and air-sealed. Flashing, caulking, and sealing around windows and doors is essential as is flashing at intersections such as roof-wall junctures.

Action items

Resources

http://www.techbuilt.com

Structural Insulated Panel Association, http://www.sips.org



Key Concepts

Alternative wall construction for energy efficiency

Photo: Insulating Concrete Forms (ICF) walls ready for poured concrete

Explanation

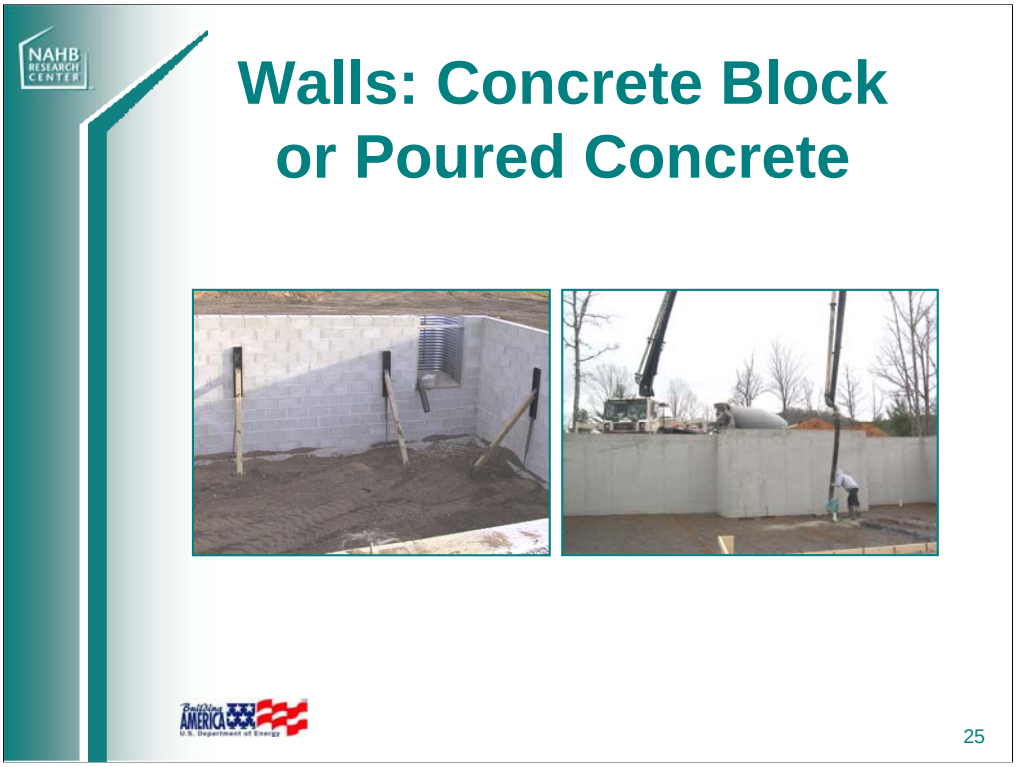
ICFs can also be used for above-grade walls. There are numerous proprietary systems available.

Action Items

Resources

Prescriptive Method for Insulating Concrete Forms in Residential Construction, available for free download at http://www.huduser.org/Publications/PDF/icf_2ed.pdf.

Insulating Concrete Form Association, http://www.forms.org



Key Concepts

Above-grade concrete construction is also an option for residential construction.

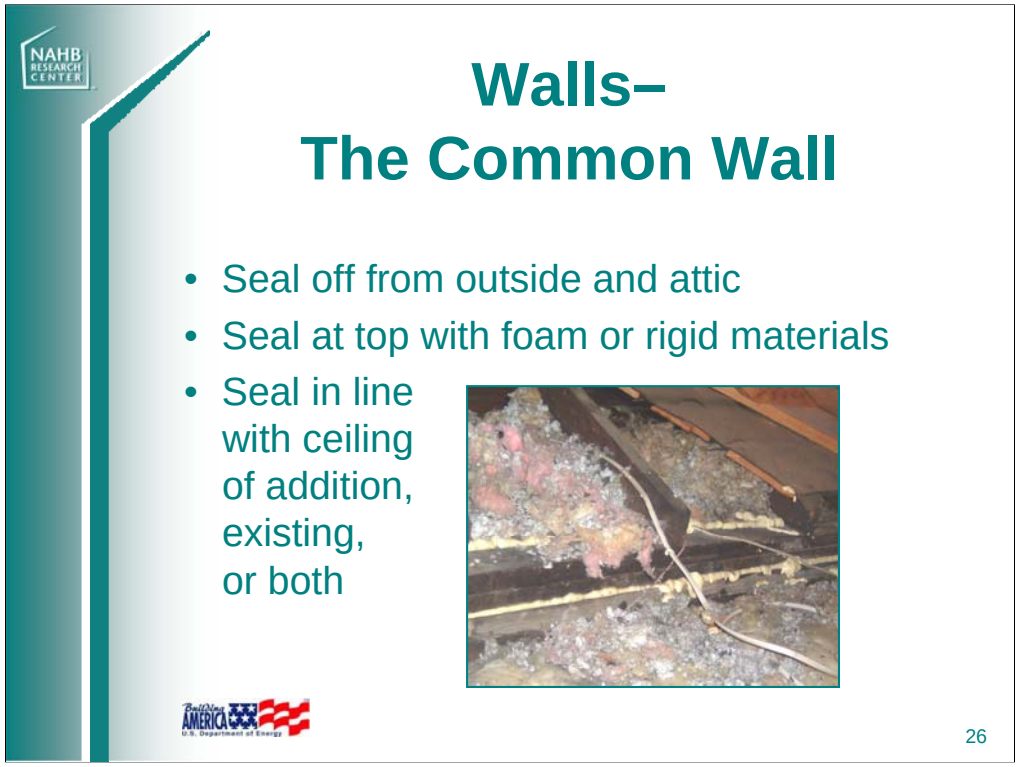
Explanation

When building an energy-efficient concrete block or poured concrete wall, it is essential to add rigid insulation on the interior or exterior of the concrete in all but the most temperate climates. Loose fill insulation such as vermiculite can also be used to fill the cores of concrete block; however, a thermal bridge remains wherever there is solid concrete from interior to exterior. Walls can be framed on the interior (steel or wood) but this adds to material and labor costs. Concrete walls can be an important part of a passive solar design—exterior insulation with the concrete exposed on the interior can provide thermal mass to store solar heat, release it slowly, and prevent overheating of a space.

Some of the benefits of concrete construction often cited by advocates include: durability, moisture resistance, noise reduction, energy efficiency, and flexibility of design and architectural style.

Action Items

Resources



Key Concepts

The common wall between existing house and addition can be a major source of energy loss.

Explanation

Photo shows top plate of existing house with expanding foam applied to open cavities in the siding and where the finished ceiling intersects the top plate.

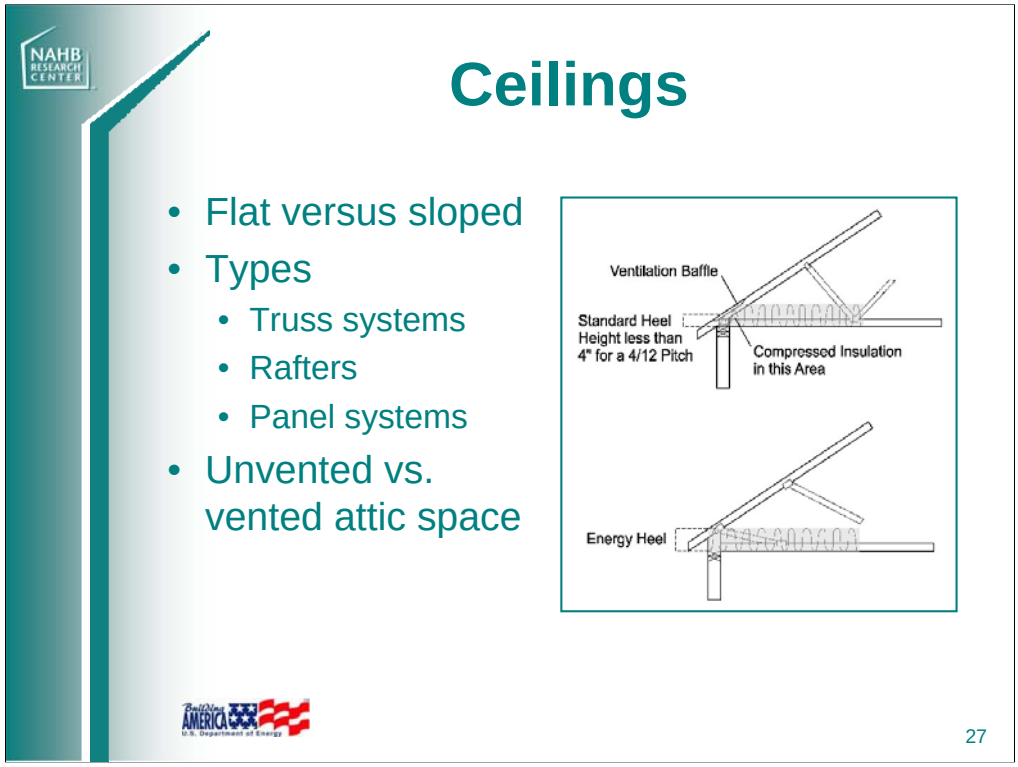
Often, the wall between the house and addition can be the coldest in the house because it is not sealed off from the outside air, is open to the attic, and contains wires and pipes that were punched through during the project. Be sure that this wall is sealed off from unconditioned basements, crawl spaces, and/or attics.

Action Items

Seal in line with the ceiling of the addition, the ceiling of the existing house, or both with rigid materials (e.g., foam or scrap lumber) or foam sealant.

Resources

David Connelly Legg, Adding Efficient Living Space, *Home Energy Magazine*, http://hem.dis.anl.gov/eehem/96/960108.html



Key Concepts

Creating energy efficient ceiling systems in an addition

Explanation

Flat ceilings are typically more energy efficient than sloped ceilings because 1) there is less volume to heat and cool, and 2) cathedral ceilings typically offer less depth for insulation than flat ceilings. Also, when lighting is installed in sloped ceilings, there is little room left for insulation. However, if ducts and mechanical equipment will be located in the new attic, it may be most efficient to insulate the ceiling at the roofline.

There are various methods for creating ceilings: rafters, standard trusses, raised heel roof trusses, and panel systems like SIPs or Techbuilt.

In most local building codes, attic ventilation is required. However, research is showing that attic ventilation is not always necessary and may, in fact, be detrimental to energy efficiency. For instance, in hot humid climates where air conditioning equipment is often located in the attic, a ventilated attic means that the humid outdoor air is introduced into the attic. This can result in condensation on equipment or ductwork. Problems with condensation have been reported when cool ductwork is buried under the insulation and lays against the ceiling. As attic temperatures climb, condensation can occur on the ductwork wetting the gyp board or ceiling finish material. Drying potential is low under these conditions and mold is likely to form.

In colder climates, moving the conditioned envelope to the roofline eliminates the difficult task of trying to carefully seal around wiring, plumbing, or HVAC penetrations between the living space and the attic. While it is still a good idea to seal around penetrations, some air leakage is not as critical once the attic is part of the conditioned envelope. When moving the conditioned envelope to the roofline and eliminating ventilation, it is essential that there is a good air barrier – especially in severe climates. Vapor barriers are not recommended in unvented roof assemblies in order to allow for drying.

Action Items

Key Concepts

Designing unvented roof assemblies

Explanation

Photo at left shows spray insulation applied to the roofline and the front porch ceiling to provide an airtight thermal barrier.

Photo at right shows installation of a SIP roof, which can provide a continuous thermal barrier that is tightly sealed.

When designing an unvented roof, the condensing surface (the roof deck) must be kept warm enough to prevent condensation from occurring. One building science firm, Building Science Corporation, recommends ensuring that the roof deck will remain above 45 degrees F under average winter outdoor temperatures. As the climate gets colder, this is accomplished by placing rigid insulation above the first condensing surface (lower roof deck). In cold climates (between 4,500 and 8,000 heating degree days), a minimum total R-value for the unvented roof assembly should be R-40. In very cold climates (more than 8,000 heating degree days), a minimum of R-50 is recommended.

Action Items

Resources

http://www.buildingscience.com/resources/roofs/

Key Concepts

Air sealing

Explanation

Air sealing the building shell prevents unwanted air infiltration and is one of the most cost effective ways to attain energy efficiency.

“Key Junctures” in framing, i.e., where walls meet floors, ceilings, etc., are major culprits in air leakage. Use rigid materials such as lumber and rigid foam, foam or caulk sealants, and gasketing material to make a tight building shell.

Photo shows air sealing the exposed wall area in an attic where the ceiling was framed to a height lower then the remainder of the house. Technician is also building an airtight cover for a recessed light.

Action Items

Keep common materials—such as a few cans of “Great Stuff” or caulk—on your truck to make air sealing simpler, faster, and more likely to get done.

Foam seal around plumbing, ductwork, and electrical penetrations between conditioned and unconditioned areas. Use airtight electrical junction boxes.

Use metal flashing and high temperature caulk to seal around fireplace chimneys.

Resources

Advanced Air Sealing. Available at www.oikos.com/library/airsealing

Air sealing materials can be purchased at a home improvement store or an online retailer such as Energy Federation Inc. (http://www.efi.org).

Key Concepts

Pay attention to the key areas in a home where air leakage can be significant.

Explanation

Photos upper: Left - The band joist between levels of the home is often overlooked. In this photo a large gap between two insulated components has been sealed with expanding foam. Middle - The intersection of the mudsill and foundation wall can be caulked or a closed cell foam roll of sill sealer can be installed between the components. Right - Subfloor openings for tub drain assemblies are usually quite large and often overlooked.

Photos lower: Left - Unlike walls, which have two air barriers, ceilings have only one barrier, the drywall. So there is only one opportunity to make this barrier air tight. Gaps between electrical fixtures or duct boots are often overlooked since grilles or trim plates conceal the gaps. Many contractors make caulking these gaps the responsibility of the paint crews. Middle - Flue flanges are often not sealed to the flue and to the surrounding framing with fire-rated caulk or expanding foam. Right - Open chases between floors are most easily sealed if pipes or ducts are run through them after solid sheathing is installed during the framing so that the pipes and ducts can be sealed to the rigid material.

Action Items

Resources

See Southface fact sheet and technical bulletin on Air Sealing.
http://www.southface.org/web/resources&services/publications/factsheets/8_airsealing.pdf

http://www.southface.org/web/resources&services/publications/technical_bulletins/AS-Airsealing%2000-767.pdf

Key Concepts

Pay attention to the key areas in a home where air leakage can be significant.

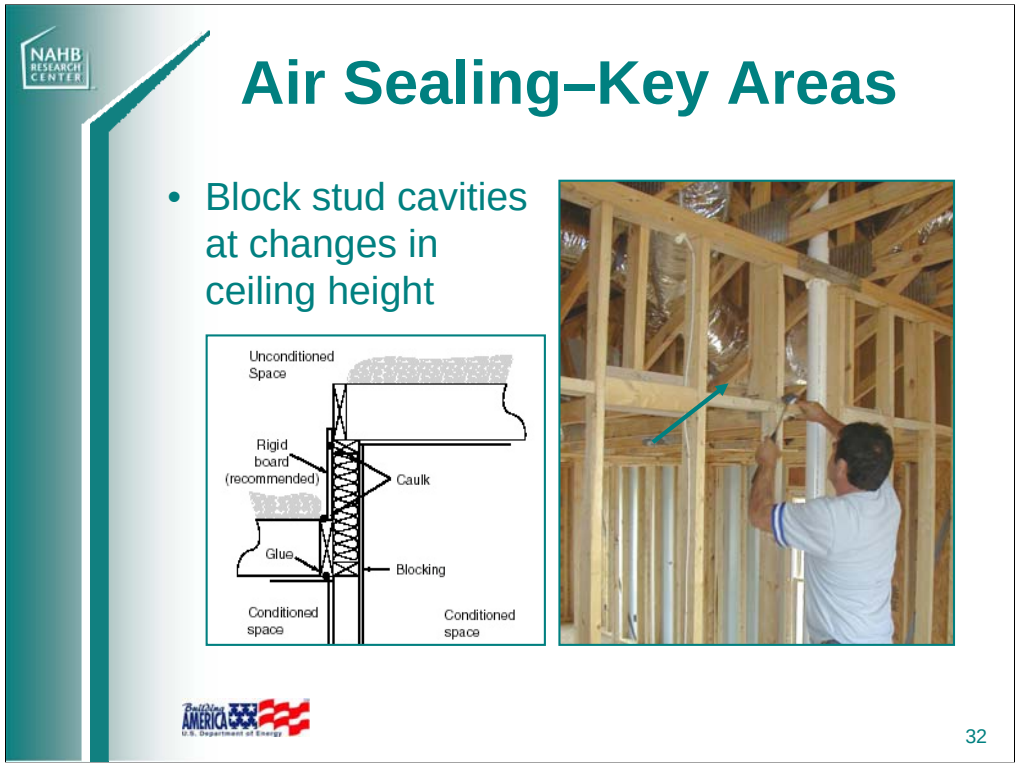
Explanation

Conventional attic pull down stairs are an air sealing opportunity – left photo and lower right. One method is to install a hinged, insulated, weatherstripped door on a raised curb. Raising the curb allows full depth insulation. Two approaches to the hinged lid are shown.

The exterior sheathing is the primary air barrier in walls. Sealing all seams in the sheathing, rather than relying on housewrap, is the most effective way to air seal walls. In this photo (upper right), a Habitat for Humanity volunteer in Atlanta is sealing the seams on foam sheathing (this house has two layers of foam sheathing applied to the walls). Because extruded polystyrene sheathing can act as a drainage plane once the seams and penetrations are sealed, no felt or housewrap is needed.

Action Items

Resources



Key Concepts

Install blocking in walls at the lower level intersection to stop air flow into wall cavities below.

Explanation

Walls above ceiling height transitions in this example are kneewalls and need sheathing air blocking.

Action Items

Resources

Key Concepts

Attic kneewalls must be sheathed and sealed to stop airflow.

Explanation

Because insulation does not stop airflow, the R-value of the batts in this photo is significantly reduced. Air leakage through the batts can create an airflow path throughout the building in hidden cavities like walls and between floors.

Action Items

Resources

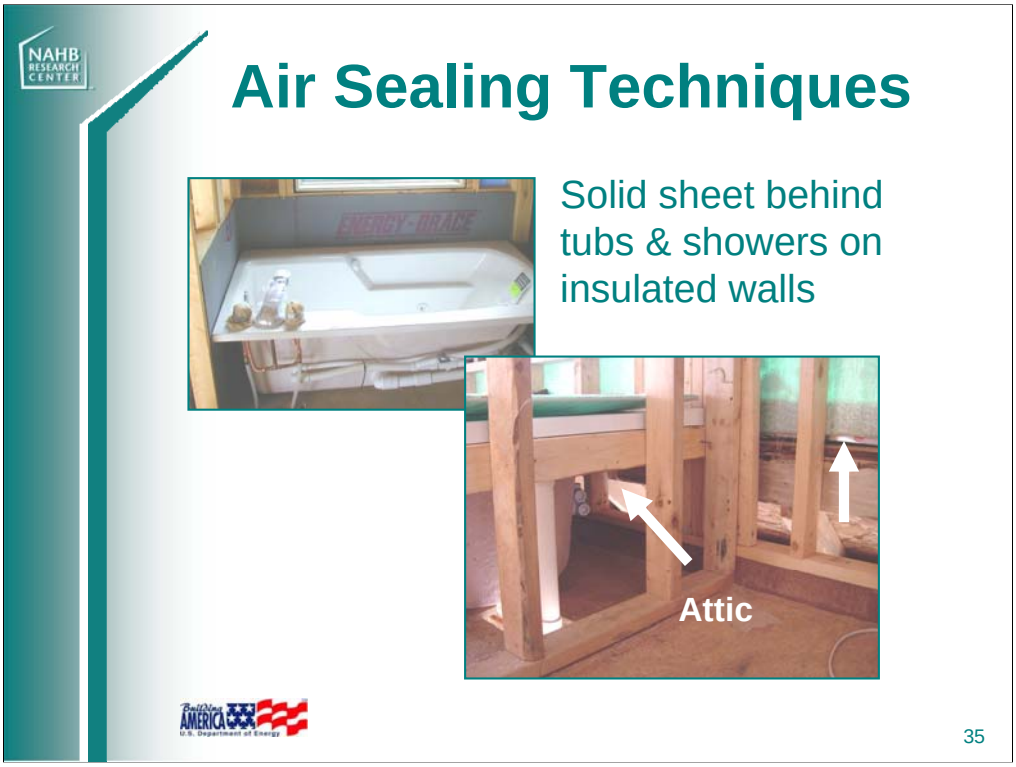
Explanation

Air sealing materials can be inexpensive sheet goods (e.g., gypsum board), caulks, and expanding foams.

Explanation

Action Items

Resources



Key Concepts

Applying sheet goods behind tubs and showers reduces air infiltration.

Explanation

In the right photo the cavity beneath the tub is connected directly to an attic under a shed roof and to the floor cavity beneath the tub. This could make the tub area quite uncomfortable and can create significant air leakage into the home. (Note also that the vertical side of the flashing on the wall above the roof was not tucked behind the drainage plane.) In the left photo Energy Brace sheathing was installed on the walls prior to the tub installation as an air barrier. Energy Brace is a 1/8-inch thick structural sheathing that, when used in this application, acts as an air barrier but does not materially affect the application of wall finishes.

Action Items

Resources

http://www.ludlowcp.com/pages/energybrace.html

Key Concepts

A continuous insulation barrier is a key component of an energy efficient addition, including areas like behind the fireplace (right photo). The fireplace is often treated without considering the continuity of the building envelope. In this photo, the exterior walls of the fireplace chase were considered as the building envelope. Prior to installing the fireplace, the walls of the chase were covered with drywall.

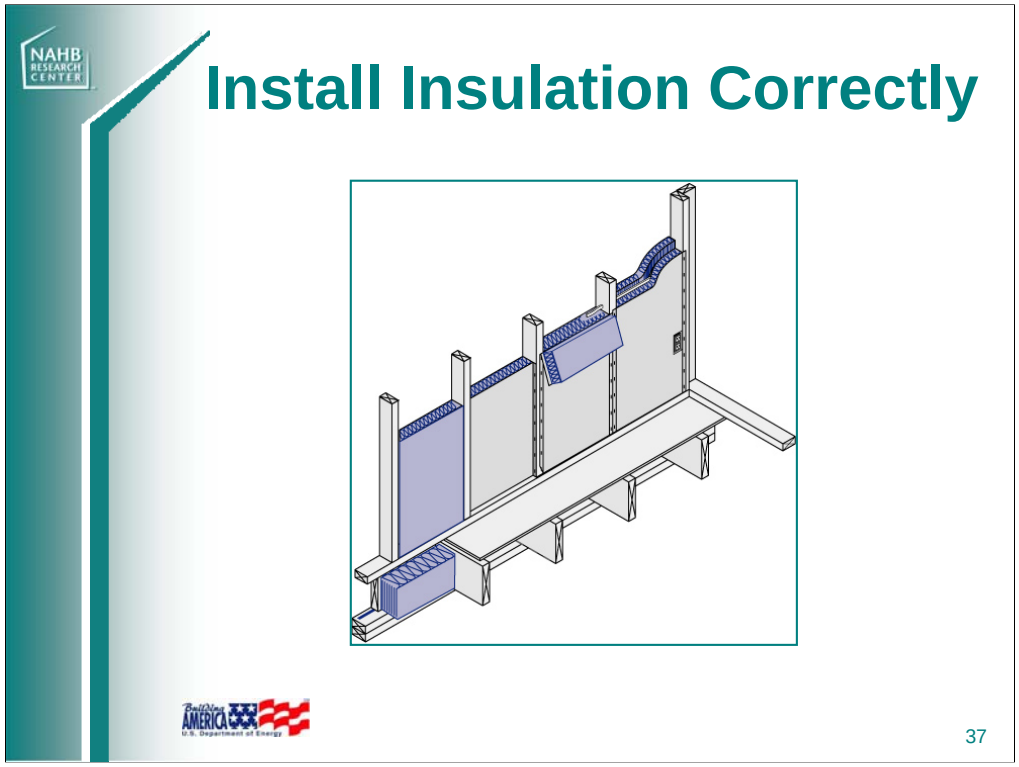
Explanation

Insulation provides \ resistance to heat flow. An even, complete insulation application is more effective than high R-values in some areas.

Make sure insulation is in contact with the air barrier. In the left photo the insulation was blown to completely fill the rafter cavity; netting was stapled to the rafters prior to blowing the cellulose.

Action Items

Resources



Key Concepts

Insulation must completely fill cavities in order to attain maximum R-value.

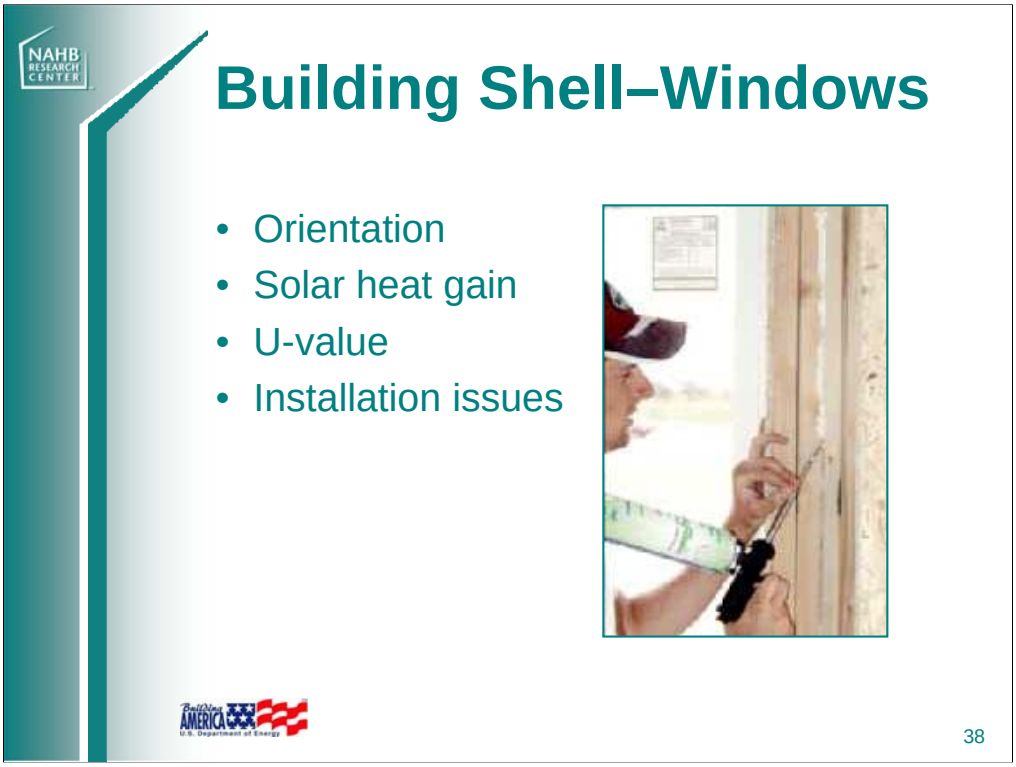
Explanation

When installing faced insulation, staple no more than ¼ inch in from the stud edge.

Cut and fit batts around wires, electrical boxes, pipes and ductwork. Batts can be split to fit around the back side of wires and pipes. Unfaced batts can be friction fit into wall cavities. Airseal rim joist areas with adhesive or caulk prior to installing batts snugly against framing.

Action Items

Resources



Key Concepts

Window energy efficiency

Explanation

Windows, especially if there are lot of them, can greatly affect the energy efficiency and comfort of a space. In general, west-facing windows should be minimized because they can lead to overheating of the space when the sun is low in the sky during the hottest part of the day; south facing windows can contribute to desirable solar heat gain (especially if they fall under overhangs which provide shade when the sun is high overhead in the summer).

When evaluating which windows to use, a good tool is the Efficient Windows Collaborative or simply to look for the ENERGY STAR label. Recommendations for window selection by climate can be found at www.efficientwindows.com.

Many windows include an NFRC label which states Solar Heat Gain Coefficient (SHGC) and U-value (the inverse of R-value). SHGC is a number between 0 and 1 that indicates the portion of incident solar radiation that is allowed through the window as heat gain (0 means no heat gain, 1 means all the incident radiation is transmitted through the window). U-value is a number between 0 and 1 indicating the amount of energy that is conducted through the window. The lower the U-value, the better the window is at insulating.

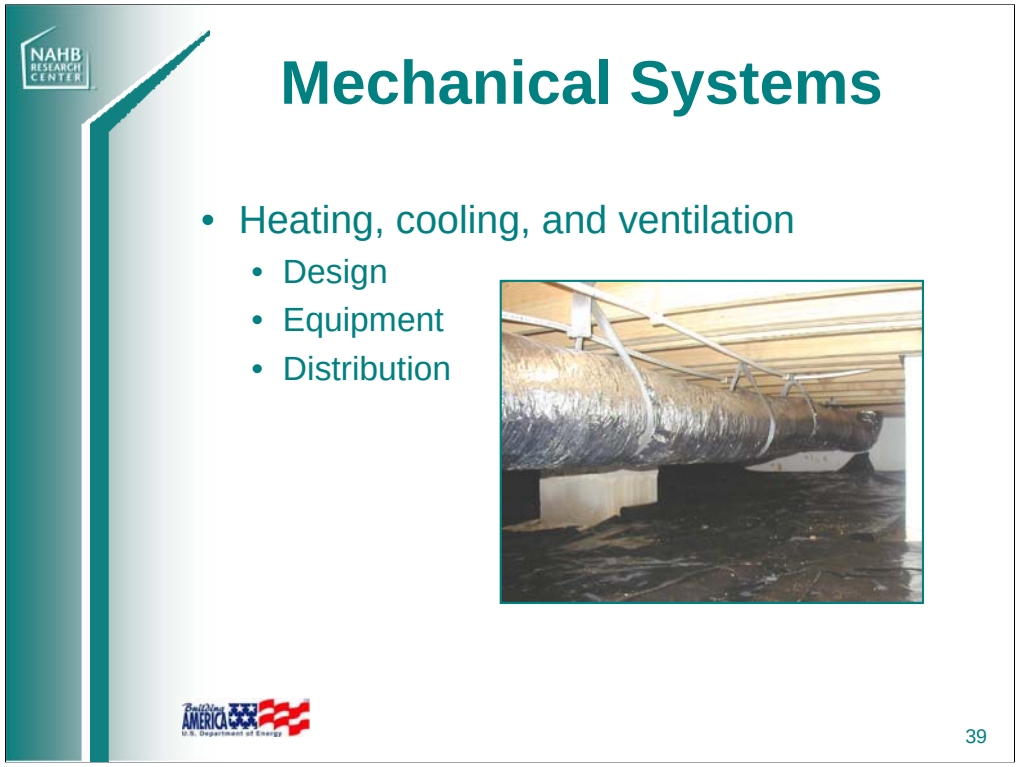
Proper air sealing between the rough opening and the window frame is essential—low expanding foams are available for this purpose and housewrap should be installed prior to windows to provide a layer of protection from wetting underneath the window. See these details in the Building Science Basics module.

Action Items

Resources

www.efficientwindows.org--makes window U-value and SHGC recommendations by climate zone. Can compare limited design scenarios/window options for fixed locations.

RESFEN—software for determining the effect of various window configurations on energy consumption of a particular home. Available for free download from http://windows.lbl.gov/software/resfen/resfen_download.htm



Key Concepts

Mechanical systems serving additions

Explanation

When designing a mechanical system for an addition, first determine if the existing system is sufficient to meet the new loads. If so, the ducts should be configured to provide supply and return air to the room and the ductwork should be insulated and sealed using mastic paste or a UL-listed aluminum tape (NOT duct tape). If the existing system is not sufficient, and you will not be making building shell efficiency improvements throughout the house that would decrease overall loads enough so that the existing system can meet the new loads, then a stand-alone space heating and cooling system or replacement of the existing system may be the best option. See Mechanical Systems module for additional discussion of this topic.

Action Items

If the existing HVAC system will not meet the loads of the new addition (after your mechanical contractor has performed a detailed energy analysis), consider upgrading other parts of the house.

If you need a stand-alone system for the addition or if you need to replace existing equipment, use ENERGY STAR labeled equipment.

Seal and insulate ducts. Seal ducts even if they run through conditioned space and are insulated well when they run through unconditioned space.

Have a well-designed distribution system for good airflow and consistent temperature between rooms.

Resources

Air Conditioning Contractors Association Manual J, D, S (load calculation, duct design, and HVAC equipment sizing). For calculating heat loads, Manual J version 8 is the latest edition and contains the most up-to-date information.

Instructor's Notes

Identify possible local contractors who could perform diagnostic testing of an existing home to provide before and after performance information.

Key Concepts

Lighting in additions

Explanation

New fluorescent technology can help bring warm, natural-looking light to an addition. Fluorescent bulbs are rated by color temperature and their color rendering index. Although this information is often hard to find, a good lighting store should be able to direct you to the right bulbs. In general, look for Color Temperature around 2700-2800 to approximate the light we are used to with incandescent lamps. A Color Rendering Index above 80 will be pleasing to the eye.

The photo shows a special kind of fluorescent fixture that accepts only permanent fluorescent bulbs (the kind that have 2- or 4-pin connectors rather than the “screw-in” variety). The fixtures are more expensive than conventional fixtures, but replacement bulbs are cheaper.

Action Items

Dispel the myth that fluorescent lighting is “ugly” by trying a few of the new bulbs (not necessarily ones you can buy at a hardware store) in your house. See if your spouse can detect the difference!

When using recessed can lighting, or when junction boxes are located in a ceiling, select the airtight, insulation contact (IC) rated variety.

Resources

Your local lighting supply store

Online retailers such as http://www.buylighting.com or http://www.goodmart.com

Manufacturer websites, such as Osram Sylvania, http://www.sylvania.com

Appliances

- ENERGY STAR label
  - Clothes washers
  - Refrigerators
  - Dishwashers
  - Small appliances

41

Key Concepts

Energy efficient appliance selection

Explanation

Although room additions won't typically involve appliance selection, the ENERGY STAR label is the easiest way to find energy efficient appliances, windows, lights, heating and cooling equipment, and office equipment.

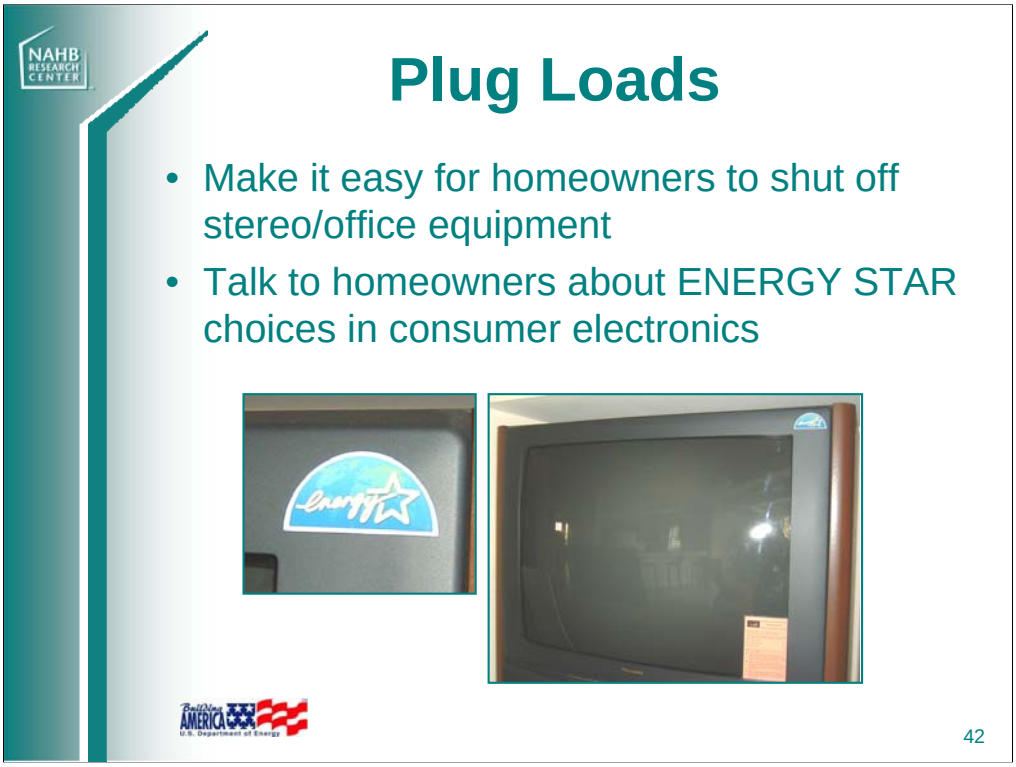
Photo at bottom shows the label on the door edge of a Whirlpool dishwasher.

Action Items

When selecting or influencing the selection of appliances for additions, select ones featuring the ENERGY STAR label. They tend to be quieter and will use less energy than conventional appliances.

Resources

http://www.energystar.gov for a database of ENERGY STAR rated appliances.



Key Concepts

"Plug" loads

Explanation

Plug loads are all the loads in the house that can be plugged into an outlet. Anything that has a remote control or a dc/ac converter uses energy while in the "off" mode.

ENERGY STAR home electronic equipment consumes less electricity when in the 'off' mode compared to equipment without the ENERGY STAR designation.

Action Items

If the customer agrees, place shut-off switches where it is easy to turn off loads that use energy continuously, even when in the "off" mode.

Talk with homeowners about choices they can make when purchasing new small appliances, e.g., there are ENERGY STAR models of cordless phones, VCRs, answering machines, office equipment, etc.

Resources

http://www.energystar.gov for a listing of consumer electronics that meet ENERGY STAR requirements.

Key Concepts

Summary

Explanation

Knowing how a house works as a system will affect your approach to many remodeling projects, sometimes saving the customer money upfront and always resulting in lower energy bills and happier customers.

Action Items

Apply what you have learned here on your next room addition!

Resources

For retail sources of energy efficiency products, see the following, among others:

Energy Federation, Inc., 508-870-2277 http://www.efi.org

Positive Energy 800-488-4340 http://www.positive-energy.com

Shelter Supply 800-762-8399 http://www.sheltersupply.com