Site Supervisors

Tools to help with project management

Building America SM U.S. Department of Energy

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In the chain of events that results in a finished home, the site supervisor (or project manager) has the critical job of turning ideas into reality. The site supervisor's job is to make sure everything happens. Plans must be correct, permits must be in order, contracts must be signed, subs must be scheduled, materials must be on site, and it all must happen on schedule. Successful construction of an energy-efficient home is essentially the same as other homes, although a few details are different and can demand more careful scrutiny because of the interdependencies in a systems-designed house.

Site supervisors working to build energy-efficient homes can generally do their jobs as they already know how, with a few simple but important changes. There are three keys to constructing any quality home—managing expectations, managing the schedule, and controlling quality and costs. This section will explain how to incorporate those three keys into your construction process.

An energy-efficient home built using these Building America recommendations looks a lot like any other home. It will maintain its visual appeal and style. The key points at which it differs typically involve more efficient HVAC equipment (including ducts), an engineered HVAC system design, a supply of outside air for ventilation, humidity control, better windows, better insulation, and better air sealing. The *Designers* chapter contains best practices recommendations on the features energy-efficient homes should include. Many builders make the comment that it's not the quantity of changes that make an energy-efficient home, but the quality that is put into building the home.

"We found no significant increase in materials costs or in subcontract labor costs. It was really more in techniques," said Walter Hendrix, Executive Director of Troup Chambers Habitat for Humanity and Dependable Affordable Sustainable Housing for La Grange, Georgia.

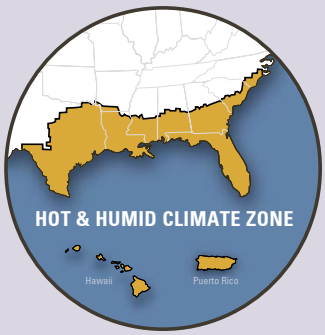
Of course, it is not always easy for a site supervisor to control all aspects of a subcontractor's work. It may be necessary, especially while these best practices are new ideas, to prioritize activities and "pick your battles." In hot and humid climates, the top priorities are 1) window selection and installation, 2) HVAC sizing and installation, and 3) moisture control.

Managing Expectations

A project manager who can foster a set of shared expectations among the important players in his or her building team can successfully build efficient houses. Two goals should influence the project manager's actions at the start of the project:

- Make sure subcontractors and in-house workers understand what you want.
- Eliminate the need for unknowledgeable (and often unskilled) laborers to make design decisions.

The following best practices will help meet these goals.



Develop a Work Plan

Decide who is going to do what. Will the plumber install insulation behind the tub or will the framer, or some other trades person? Develop a schedule for the order that activities should occur to be sure that actions are done in a reasonable order and that no actions will be forgotten. Be sure that all needed materials are on the site when the activity is scheduled to take place. More information on scheduling is included in the Managing Execution section.

Plans – Get Them Right

Best Practice: Before starting a project ensure that plans are correct and that you have everything you need to go forward. Once you have the plans you need, follow them.

PLANS
Make sure they are correct and follow them closely.

Existing stock plans will likely need to be modified to both include necessary changes and to add details not commonly included in residential prints. See the Design section for a description of design best practices.

A well-designed home should have well-designed plans that include everything necessary to explain expectations to the subs. Some points that should be included are:

- HVAC design details and duct layout. The duct layout must be included on a floor plan. The duct and diffuser sizes, quantities, and locations must be installed as specified. Subcontractors should be contractually obligated to these specifications. Performance requirements (such as SEER and AFUE) for system components should be specified on the plans.
- Framing plan. If advanced framing is to be included in the design, a detailed plan is needed showing how advanced framing techniques will be applied. These should detail the placement of studs to ensure proper "stacking" in two-story homes and should show details of window and door framing. Advanced framing is not required to achieve 30% energy savings in the hot and humid climate but is an important money and time saving measure for more highly efficient homes.
- Other call-outs or specifications. Call-outs and specifications should be written to detail how particular measures will be installed, including both the techniques and the materials to be used. Of particular importance are specifications and call-outs for items that differ from local standard practice such as caulking; draft stops behind bathtubs, stairs, and dropped ceilings; duct sealing requirements; gasket materials; window schedules specifying U-factors and SHGCs; and product performance metrics. Also call out items that should not be done, such as caulking ceiling penetrations under conditioned attics.

Plans — Keep Them Right

Best Practice: Avoid plan changes. When they are required, document the changes as you would the original contract.

AVOID CHANGES
Thoroughly document any changes to plans.

Numerous difficulties can be avoided with correct building plans. If the plans have been properly developed, with the proper sizing of equipment, you must be sure that changes will not undo this good work. The practice of verbally communicating changes

is always risky and is potentially disastrous for a systems-designed home where high-performance features interact to achieve energy efficiency, comfort, and durability. Before making any changes ask yourself these questions:

- Why are the changes being made? If there are no clear benefits from the change, don't do it.
- What effect will the change have on building performance? Will the change deviate from best practice recommendations? Will you need to change HVAC sizing or system selection? If you don't know the answer to these questions, ask your HERS rater. Be sure to adjust all the systems related to the change.
- Are new drawings or specifications needed to clearly document your expectations? Be clear in your expectations.

Contracts – Write Them Down

Best Practice: Prepare or update formal contracts with key subs that clearly show what you expect of them and what they can expect from other subs. Relevant call-outs, plans, and specifications described in the last section should be referenced in the contracts. If the sub is providing materials, list the specific materials that you want. Here are some examples of materials that a sub may supply:

WORKING WITH SUBS
Always prepare formal contracts and be clear about your expectations.

- Recessed downlights, which should be air-tight and rated for insulation contact
- Mastic to seal ducts
- High-density fiberglass insulation
- Sealants and caulks to seal penetrations
- Windows are typically ordered along with other major purchases, but if the sub is supplying them, be sure they are rated as called out in the plans
- Draft-stopping sheathing.

If you have expectations for a sub, such as sealing certain types of holes, or installing insulation in some space that may become inaccessible, be sure these expectations are spelled out in the contract. The scope of work should cover things like equipment size, duct sizes, identification of who is responsible for sealing which holes, etc. Contract specifications and written assignments of responsibility can greatly simplify the ordering of materials. Duct installers, for example, will know exactly what kind of duct material will be used and how much; and with this knowledge may be able to prefabricate many of their assemblies back at the shop, rather than in the field. These pre-assembled pieces tend to be of higher quality thanks to the proximity of tools and materials and better working conditions in the shop.

Pre-Construction Meeting – Have One

A final strategy to manage expectations among the subs is to hold a pre-construction meeting that includes as many of the subs as possible. At this meeting you can emphasize the changes in workflow, shifts in responsibilities, and newly introduced building details. Tell your subs about your goals for energy-efficient houses.

Give the subs drawings and instructions on how to accomplish their jobs. Sample instructions are included in the Trades section. This meeting will go a long way toward helping people to understand their roles and responsibilities. Make sure that your subs are aware that you will be conducting inspections and that both the ductwork and the building envelope will be tested for air tightness.

It may be necessary, especially when starting your first energy-efficient homes, to hold additional training sessions with key subs. More on this is discussed in the *Managing Quality* section below.

Permits – Grease the Skids

A home built according to the instructions contained in this document for the hot and humid climate does not violate any provisions of the national model codes or, usually, of local regulations. However, many local code officials are unfamiliar with some of the recommended construction techniques. It is well worth your while to raise these issues yourself before construction begins so that you're not surprised by a red tag later. (Ensuring that the "new" techniques are clearly delineated on the building plans can also help flag these issues during plan review rather than during inspection.)

A meeting with the building department before construction is well-advised. Should your code official need information in support of any of the new techniques used in an energy-efficient home, *Appendix III* contains several "tear-outs" that may be helpful. These cover some of the more common features that surprise many officials and should help in assuring your local official that the proposed techniques are both safe and in compliance with the model codes.

Managing Execution

If you've managed to establish clear expectations with your subs and suppliers, you're almost ready to begin construction. The final parts of the plan involve training subs as necessary, scheduling everything, and monitoring progress.

Training

Best Practice: Attend and have your key subs attend a training course on systems-designed housing.

SYSTEM DESIGNED HOUSING
Be sure to attend a training on systems-designed housing.

One good way to accomplish this may be to let your Home Energy Rating System (HERS) provider (see Quality Assurance below) conduct the necessary training. Information on general training is available from:

- Building America – www.buildingamerica.gov
- Energy and Environmental Building Association – www.eeba.org
- Building Science Corporation –www.buildingscience.com/workshops/default.htm
- National Association of Home Builders Research Center – www.nahbrc.org
- Southface Energy Institute – www.southface.org
- IBACOS – www.ibacos.com

Other sources may include regional universities or Cooperative Extension Service programs, homebuilder associations, utilities, and codes programs. More specialized training is available at the above sources, plus trade organizations, such as:

- Air Conditioning Contractors Association – offers technician certification – www.acca.org
- American Architectural Manufacturers Association – offers window installation master certification – www.aamainstallationmasters.com

Scheduling

Constructing an energy-efficient home requires careful attention to scheduling. Several of the new construction techniques may require changing the order of subs; some require (or benefit from) a shifting of responsibilities from one sub to another; and some new activities will need to be added into the schedule. Here are some of the more important schedule considerations:

- Schedule HVAC rough-in before plumbing and electrical. It is far more important for the ductwork to have un-constricted access and pathways than it is for wires or pipes.
- If using a conditioned attic, schedule insulating under the roof deck before HVAC rough-in. The insulators must be able to do their job without tromping on the carefully placed ductwork.
- Don't forget to schedule for pipe insulation under the slab.
- Be sure to schedule pre-drywall insulation inspections, flashing inspections, and envelope and duct pressure tests. Inspect at key points to ensure that insulation and envelope sealing take place before areas become inaccessible. Inspections are much more likely to happen if scheduled. And subs may be a bit more conscientious if they know their work will be evaluated.
- Be sure to schedule caulking of electrical and plumbing penetrations after drywall is completed and the lines have been installed.

Some situations that may require a shifting of responsibilities include:

- If using advanced framing techniques that include two-stud corners and floating drywall corners (see the section on wall framing in the *Designers* chapter and *Appendix III*), someone must attach drywall clips. The framer is a more likely candidate than the drywall installer.
- Some caulking work needs to be done by the HVAC subcontractor. In particular, main supply and return trunks that lead through walls need to be caulked by the person connecting them to the equipment. Don't let the drywall finisher do this with mud—it is neither a good sealant nor durable enough. Also, all duct terminations, including jump ducts, must be sealed when registers are installed.
- Some post-finish caulking can be avoided by having the electrician use pre-fabricated air-tight electrical boxes (see the *Trades* chapter for an electricians tip sheet).

- If installation of windows and housewrap (or other drainage planes) are done by different subs, the window installer must be careful to leave flashing unattached at the bottom so that the first row of building paper may be tucked under it (see the *Trades* chapter tip sheets for window flashing, house wrap, and sealants).
- If you are using insulated headers, the framer will need to install insulation inside any double headers (using sandwiched foam insulation). Open headers may be left for the insulation contractor.
- Draft stops must be installed behind bathtubs and stairwells on exterior framed walls. The framer should do this, but be sure that insulation is installed before the draft-stop material goes on.

Quality Assurance

Inspections

Best Practice: Conduct several inspections during the course of construction, always conduct pressure tests of both the whole house and the HVAC ductwork, and always check AC and heat pump refrigerant charging. Have the house rated by a Certified HERS Rater.

INSPECTIONS
Conduct inspections throughout the construction process.

Especially when energy-efficient systems-designed housing is new to your subs, you should conduct multiple inspections to ensure that the subs have understood what is required of them and how to implement it. After the process has become more routine, you might get by with just a couple of inspections. One key inspection should occur prior to installation of drywall.

The pre-drywall inspection allows you to ensure that insulation and draftstopping have been properly installed before they get permanently enclosed. This is also the best time to conduct a pressure test on the ductwork. The duct pressure test should be conducted with the HVAC contractor present, at least for his or her first several energy-efficient homes. If the ductwork fails to meet the pressure criteria, a smoke test will reveal the worst leaks. It is crucial that this happen while the ductwork is still visible and the HVAC contractor is present to see what the problem areas are.

Duct testing services can be most easily obtained through a Certified HERS rater. The rater can also conduct whole-house pressure tests and assist with training. And the HERS rating itself can be a valuable marketing tool for an energy-efficient house. To identify a certified rater in your area, check the registry at the Residential Energy Services Network (RESNET) web site: www.natresnet.org.

The second important inspection comes after completion of the home, including all interior and exterior finishes. This pre-occupancy inspection should check for proper sealing of electrical and plumbing (fixtures and drywall penetrations), HVAC registers, and the HVAC closet. A whole-house air leakage test (aka “blower-door” test) is crucial. Again, your HERS provider is the easiest resource for this service, and this is when he or she would be rating the home anyway. Also, if your HVAC contractor has not done it, a final check of the AC or heat pump refrigerant charge is crucial. Studies have shown that failure to check refrigerant charging results in the average system using 13% too much energy. [Ref: http://hem.dis.anl.gov/eehem/00/001105.html]

Energy Efficiency Checklists

A successful energy-efficient building involves many details. It is worthwhile to maintain for each house a checklist of important features to keep track of what has been done. Although the best checklist is one you've made specific to the design(s) you are implementing, the following is a good baseline to work from and may be integrated with your existing checklists.

SPOT-CHECK INSPECTION CHECKLIST

These items should be checked if possible as they are installed because they may not be accessible at the pre-drywall inspection.

- ☐ Grading is sloped at 5% away from the house for at least 10 feet. Roof drainage is directed at least 3 feet beyond the building.
- ☐ A 6-mil polyethylene sheet is installed directly beneath the concrete slab, continuously wrapping the slab and the grade beam.
- ☐ Roof materials are installed to provide a continuous drainage plane over the entire surface of the roof. Wall/roof junctures should be appropriately flashed, including kick-out flashing at the bottom.
- ☐ HVAC system is appropriately sized and installed according to plans. No deviations should be made in the field.
- ☐ A mechanical ventilation system is installed as specified in the plans.
- ☐ Each bedroom has a separate HVAC return duct, a transfer grille, or a jump duct.

PRE-DRYWALL INSPECTION CHECKLIST

Note: Some measures in this list are unnecessary depending on whether the house is sealed on the interior (e.g., air-tight drywall) or exterior (e.g., sheathing) of the wall.

- ☐ Bathtubs on exterior walls have insulation behind them and draftstops installed.
- ☐ Dropped ceilings, dropped-soffit cabinets, and stairwells on exterior walls have draftstops installed behind them (unless drywall was installed prior to framing-in).
- ☐ Windows and doors are sealed to framing using caulks, foams, backer rod, and/or similar.
- ☐ Window flashing is properly installed to shed water.
- ☐ All electrical and plumbing penetrations between conditioned and unconditioned spaces are caulked or otherwise sealed.
- ☐ All recessed lights beneath unconditioned spaces are air-tight and rated for insulated ceiling (IC). All kitchen and bathroom fans are appropriately rated (capacity and sound) and exhausted to the outside.
- ☐ All exterior penetrations (exterior light fixtures, phone and other service cables, etc.) are sealed with caulk, gaskets, or similar.
- ☐ All housewrap seams are overlapped and taped; top and bottom edges are sealed past the plates; housewrap is appropriately lapped under window flashing.
- ☐ Building paper seams are overlapped shingle style to shed water and appropriately lapped under window flashing.
- ☐ If housewrap is used, all seams are overlapped and taped; top and bottom edges are sealed past the plates; housewrap is appropriately lapped under the bottom window flashing.
- ☐ Batt insulation is unfaced or blown-in insulation is used.
- ☐ No vapor retarder is installed on the inside of the walls.
- ☐ Ductwork is sufficiently air-sealed as verified by a duct pressure test conducted by a HERS rater. Ductwork leakage to the exterior should be not more than 5% of the total air handling unit capacity (at high speed) when tested at 25 Pa pressure.

PRE-OCCUPANCY INSPECTION CHECKLIST

- ☐ Entry of main supply/return ducts into air handling unit closet is appropriately sealed with foam, caulk, or similar materials (NOT with drywall mud).
- ☐ Plumbing penetrations through drywall are air sealed.
- ☐ Electrical switch and outlet boxes are sealed to drywall with caulk or gaskets.
- ☐ Light fixture boxes are sealed to drywall with caulk or gaskets.
- ☐ Bathroom and kitchen fans are sealed to drywall with caulk or gaskets.
- ☐ Bathroom and kitchen fans are drawing air-tested with a small piece of tissue; the fan should hold the paper against the grill.
- ☐ Duct boots/registers are sealed to floor or drywall with caulk or gaskets.
- ☐ Attic hatches and kneewall entries are weatherstripped.
- ☐ Refrigerant charge on air-conditioner/heat pump is verified in writing by installer to be within specs, using superheat method for non-Thermostatic Expansion Valve systems or subcooling method for TXV systems; this may require a return visit during warm weather.
- ☐ The whole-house envelope is sufficiently air-sealed as verified by a whole-house pressure test. Air leakage should be tested by a HERS rater and should be less than:
  - ○ 2.5 in^2 per 100 ft^2 of envelope area (CGSB, calculated at a 10 Pa pressure differential), or
  - ○ 1.25 in^2 per 100 ft^2 of envelope area (ASTM, calculated at a 4 Pa pressure differential), or
  - ○ 0.25 CFM/ft^2 of envelope area when tested at a 50 Pa pressure differential.