

## 2.1 REDUCE QUANTITY OF MATERIALS AND WASTE

### 2.1.1. Create an efficient floor plan that maintains a home's functionality

**Intent:**

Use the local data regarding the average size of homes built (taking bedrooms into account), and get credit for building a home with the same number of bedrooms but with fewer square feet than an average-sized house.

Size homes, rooms, and wall heights based on available material sizes. Two-foot modules work well for floor plans. Wall height should be based on availability of structural framing members in pre-cut lengths (i.e., pre-cut stud lengths).

Use designs that incorporate efficient mechanical systems layout, like stacked "wet walls" for efficient plumbing layout, minimized pipe runs, and rapid hot water delivery. Dedicate one "wet wall" per floor, i.e., kitchen sink and powder room or master and guest baths with back-to-back layouts that share a plumbing wall. Locate walls that contain drain/waste/vent and supply pipes on interior walls. (Section 5.3.5, Indoor Environmental Quality, also covers the design practice of installing water supply lines on interior walls.)

When homes require forced-air space conditioning, incorporate the HVAC duct layout in the architectural plan and design the ducts into the conditioned space of the building to maximize system efficiency.

**Information / How to Implement:**

NAHB Research Center national survey data regarding average size of homes:

- 2 BR = 1,382 sq. ft.
- 3 BR = 1,890 sq. ft.
- 4 BR = 2,648 sq. ft.
- 5+ BR = 3,424 sq. ft.

In the table below, note that the square footage of a 2 BR house must be reduced by 50 square feet to obtain an additional point. In order to determine how much the homes with 3, 4, and 5+ bedrooms must be reduced, we referenced the national data (see above). The average 3 BR house is 37% larger than the average 2 BR; the average 4 BR is 40% larger than the average 3 BR; the average 5+ BR home is 29% larger than the average 4 BR. These percentages were used in the table below to determine the house size thresholds.

For example,

- a 1,825 sf. home is 37% larger than a 1,332 sf. home;
- a 2,555 sf. home is 40% larger than a 1,825 sf. home;
- a 3,296 sf. home is 29% larger than a 2,555 sf. home.

## GUIDELINES FOR EFFICIENT FLOOR PLAN DESIGN

| Area of Home (Square Feet)<br>(Based on ANSI Z765-2003) | # of Bedrooms |      |      |      | Points |
|---------------------------------------------------------|---------------|------|------|------|--------|
|                                                         | 2             | 3    | 4    | 5+   |        |
|                                                         | 1382          | 1890 | 2648 | 3424 |        |
|                                                         | 1332          | 1825 | 2555 | 3296 |        |
|                                                         | 1282          | 1756 | 2459 | 3172 |        |
|                                                         | 1232          | 1688 | 2363 | 3048 |        |
|                                                         | 1182          | 1619 | 2267 | 2925 |        |
|                                                         | 1132          | 1551 | 2171 | 2801 |        |
|                                                         | 1082          | 1482 | 2075 | 2677 |        |
|                                                         | 1032          | 1414 | 1979 | 2553 |        |
|                                                         | 982           | 1345 | 1883 | 2430 | 8      |
|                                                         | 932           | 1277 | 1788 | 2306 |        |

### Resources:

- Use the newly modified American National Standards Institute (ANSI) Z765-2003 to calculate square footage. Available from the NAHB Research Center Bookstore—  
[www.nahbrc.org/tertiaryR.asp?TrackID=&CategoryID=1652&DocumentID=2636](http://www.nahbrc.org/tertiaryR.asp?TrackID=&CategoryID=1652&DocumentID=2636)
- Oikos®, Small, Efficient and Beautiful, 17 Space Design Tips. <http://oikos.com/esb/52/smallefficient.html>
- There are many resources available to help a builder create efficient home floor plans. For example, Sarah Susanka's *Not So Big House* series of books can assist in home design. *The Not So Big House* (The Taunton Press, 1998); *Creating the Not So Big House* (The Taunton Press, 2000)
- GreenBuilder, Sustainable Building Sourcebook, [www.greenbuilder.com/sourcebook/](http://www.greenbuilder.com/sourcebook/)
- Environmental Building News and BuildingGreen.com, GreenSpec Directory  
[www.greensage.com/BOOKS/GreenSpecs.html](http://www.greensage.com/BOOKS/GreenSpecs.html)

### 2.1.2. Use advanced framing techniques that reduce the amount of material used to build a home while maintaining the structural integrity of the home.

#### Intent:

Advanced Framing or Optimum Value Engineering refer to framing techniques that reduce the amount of materials used to build a home while maintaining its structural integrity. An optimum value-engineered assembly tends to use less energy for space conditioning because the omitted (and redundant) structural components can be displaced with insulation. Accordingly, the user will note that some advanced framing techniques receive points for both Resource Efficiency and Energy Efficiency.

#### Information / How to Implement:

Advanced framing elements can be applied independently, or adopted in their entirety, depending upon the specific requirement(s) of the project. Framers unfamiliar with the techniques may need training, and the initial use of these techniques may temporarily slow down framing operations. In general, more planning is needed to implement these elements.

In addition to the advanced framing techniques described below for wood, homes with steel framing can incorporate advanced framing techniques, including 24-inch on-center spacing for steel floors and walls, described in the HUDUSER's Prescriptive Method for Residential Cold-Formed Steel Framing (see Resources section of this line item for additional information).

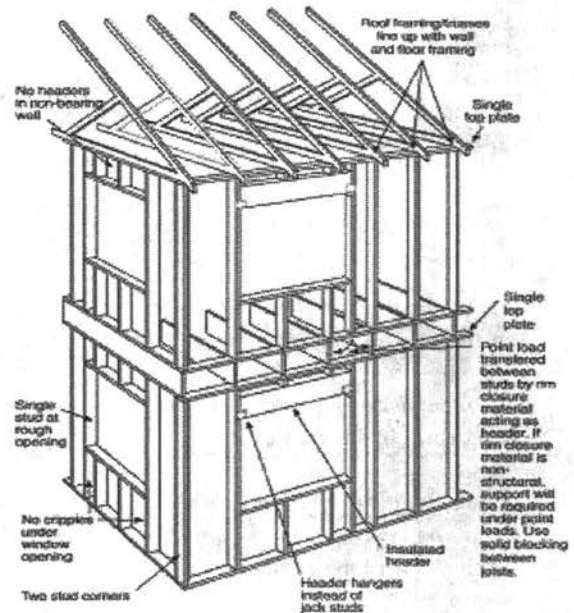
Some of the benefits of advanced framing include:

- Reduced first cost (3% to 5% of framing cost)
- Improved energy efficiency (2% to 5% per year)
- Improved resource efficiency (less wood consumption and waste).

Advanced framing uses engineering principles to minimize material usage while meeting model building code structural performance requirements.

The following list covers different principles that form an advanced framing system:

- 19.2-inch or 24-inch on-center framing, floor systems
- 19.2-inch or 24-inch on-center framing, bearing walls
- 24-inch on-center framing, roof systems
- 24-inch on-center interior partitions
- Single top plate walls
- Right-sized headers or insulated (box) headers (where required)
- Eliminate headers in non-bearing walls
- Doubling the rim joist in lieu of header (2x6 or deeper wall framing)
- Ladders blocking at interior-wall-to-exterior-wall intersections
- Two-stud corner framing



Builders need to employ at least two of the items above in order to get four points for this line item. An additional point may be added for each additional technique employed to a maximum of eight points.

### 19.2-inch and 24-inch ON-CENTER FRAMING

**Details:** Wall and floor framing spacing can often be engineered for 19.2-inch (one-fifth of an eight-foot sheet) or 24-inch on center (one-fourth of an 8-foot sheet). Roof framing that utilizes trusses is most frequently spaced at 24-inches. This strategy can be combined with modular layout and single top plate for added economy but can also be used independently.

**Installation:** Installation should be in accordance with manufacturer's specifications and model building code prescriptive methods. Bracing and fastening schedules and sheathing thickness requirements increase with framing spacing.

Careful spacing of window and door openings will maximize the economy of wider spacing. Designs that are built repeatedly should include wall framing layout drawings to guide the framing crew. When first implementing advanced framing elements, crews are likely to be slowed down until they become more familiar with the method.

**Benefits/Cost:** Approximately one-third of the lumber can be eliminated from the wall and floor framing of a value-engineered house, over walls and floors spaced 16 inches on center. Floor joists may need to be deeper for wider spans, but the reduction in lumber required for the building usually offsets the price increase from having larger floor joists. The need for thicker deck sheathing will also offset a portion of the savings. A careful analysis or a trial prototype is needed to determine whether the wider spans make economic sense for a particular plan. In general, simpler plans designed on a two-foot module are much more likely to result in savings with 24-inches on center framing than are complex plans with odd dimensions and many small offsets. However, resource savings will occur regardless of economic savings.

Wider stud spacing contributes to energy efficiency by reducing the amount of lumber in a wall cavity. Since more insulation and less lumber is used, and since insulation has a higher R-value than lumber, increasing stud spacing increases the overall R-value of the wall system. Limitations: Floor decking, wall cladding, roof sheathing, and interior finish material (such as gypsum wallboard) need to be sized to span the added dimension without undesirable deflection. If floor joists are chosen that have wide flanges, this will reduce the clear span of the floor decking. Material fastening schedules and sheathing thicknesses become more stringent when wider spans are employed, which may affect quantities, installation time, and cost of accessories.

One-half-inch-thick gypsum board will deflect somewhat more over 24-inch framing than 16-inch framing, although it is commonly used. An alternative would be to use half-inch “anti-sag” or five-eighths-inch” gypsum board.

Some manufacturers do not make insulation batts for 19.2 inches on center framing. Therefore, using this spacing in an insulated wall assembly may require changing type or brand of insulation.

In some markets, there is a perception that wide-spaced framing is a mark of inferior construction. Attention to all of the details of assembly, including fastening and bracing schedules, will assure that the system performs well.

**Code/Regulatory:** Model codes allow bearing walls framed with 2x4 studs spaced 24 inches on center or single top plates on bearing walls within defined structural guidelines. Designs in high-wind zones or with tall walls may not allow 24-inch on-center spacing.

#### **SINGLE TOP PLATE—EXTERIOR AND BEARING WALLS**

**Details:** Single top plates are typically incorporated with advanced framing designs that include 24 inch on center framing. By stacking the wall and roof framing, it is possible to use a single top plate because the top plate merely transfers compressive vertical loads to the stud below. Steel plates or straps are used to maintain continuity of the plate in the absence of a second, overlapping plate.

**Installation:** Temporary bracing is needed to steady and plumb newly erected walls. As with all light frame structures, temporary bracing should be left in place until the floor and/or roof is completed to permanently brace the structure.

**Benefits/Costs:** In a 28-foot x 40-foot two-story house, the savings from eliminating second top plates in bearing and non-bearing walls is equivalent to eliminating about 35 studs. Because one plate is omitted, the amount of wall insulation is increased, slightly improving energy performance.

**Limitations:** May not work on homes in high-wind or earthquake zones. Requires purchasing a longer stud.

**Code/Regulatory:** Meets model codes in some designs, but is more likely than other OVE practices to raise questions from building officials.

#### **SINGLE TOP PLATE—INTERIOR NON-BEARING PARTITIONS**

**Details:** Any non-bearing partition can be built with a single top plate.

**Installation:** Bracing is needed to steady and plumb recently erected walls. This bracing should be left in place until the floor or roof above the walls is completed, tying the structure together.

**Benefits/Costs:** Savings depend on the design's linear feet of non-bearing walls. In a 2,200-sq. ft. home, the equivalent of two or three dozen studs is likely to be saved on interior walls.

**Limitations:** If used along with a normal double plate on bearing and exterior walls, two lengths of wall studs are required on the job, which could be confusing.

**Code/Regulatory:** Meets codes but is more likely than other OVE techniques to inspire questions from the building official.

## **RIGHT-SIZED HEADERS or INSULATED BOX HEADERS**

**Details:** Instead of sizing all headers in bearing walls to accommodate the greatest load case, size each header for its actual load and span using the appropriate wood species. Also consider the benefit of using a deeper, single-ply, and engineered wood header.

If the tedium of framing different header depths to uniform head heights at openings is daunting, use insulated box headers that facilitate load transfer above openings and use fewer resources than two-ply solid sawn members. Typically, a boxed header design consists of a top and bottom 2x4 on the flat, some end and interior cripples, and a plywood face on one or two sides. The hollows in the header interior allow insulation to be added.

**Installation:** Headers of various sizes require framers to pay attention to plans and customize openings. An alternative would be to site-fabricate and insulate box headers of a consistent depth and install these in lieu of dimensional or engineered wood headers.

**Benefits/Costs:** Material cost and usage economies must be balanced against the chance of installing the wrong-sized header and slowing down the framing process by making opening head framing inconsistent. Similarly, material economies associated with fabricating box headers of consistent depth will be offset by labor involved with fabricating these onsite. The need to have an additional material, insulation, on hand at the rough frame stage makes the bill of materials more complex.

Reducing the use of large-dimensioned lumber is environmentally desirable.

**Limitations:** Without thoughtful implementation, right-sizing headers could result in uneven window and door head heights. The practice requires cutting different-sized cripples over headers.

**Code/Regulatory:** Model building codes include prescriptive methods for sizing headers and girders, as well as sizing and constructing box headers.

## **NO HEADERS IN NON-BEARING PARTITIONS**

**Details:** Although it is obvious that headers are not needed in non-bearing partitions, it is not always obvious which partitions are load bearing and which are not. Thus, framers often put headers over every opening to be safe. Eliminating these headers saves both material and labor.

**Installation:** If a method of identifying bearing walls versus non-bearing partitions is included on the plans, the layout framer can determine which openings need headers. For instance, solid blue walls can denote bearing and uncolored walls can be non-bearing.

**Benefits/Costs:** Saves material and labor cost, and conserves resources by reducing the use of wide-dimension lumber.

**Limitations:** None.

**Code/Regulatory:** Model codes do not prescribe headers in non-bearing locations, although it may be necessary to demonstrate to the inspector that a partition is non-bearing.

## LADDERS AT PERPENDICULAR WALL INTERSECTIONS

**Details:** Use flat horizontal blocking between studs to secure a perpendicular wall rather than solid vertical framing. (With 24 inches on center wall framing, three 22-1/2-inch scrap pieces are set at 24 inches on center vertically to replace two studs.)

**Installation:** Cutting and nailing three pieces of blocking requires approximately the same labor as installing two studs.

**Benefits/Costs:** Less lumber is used, and scrap pieces can be used for blocking. The horizontal blocking stiffens the wall junction. Most important, insulation in the exterior wall can be installed continuously behind the ladder frame.

**Limitations:** Blocking should be set so that it does not conflict with light switches and outlets.

**Code/Regulatory:** The system has no impact on model codes.

## TWO-STUD EXTERIOR CORNER FRAMING

**Details:** Only two studs are needed at an outside building corner, one at the end of each intersecting wall end. Any additional framing is needed only to support the gypsum board at the inside corner. Gypsum can be supported either with a flat stud, to leave an open-ended cavity at the corner; or with drywall clips, thus eliminating the need for a third stud.

**Installation:** If using a third stud for gypsum board backing, the extra stud can be a 2x4, even if the wall is composed of 2x6 studs.

**Benefits/Costs:** With a two-stud corner, one stud is eliminated. In all cases, the open cavity at the corner can be insulated along with the wall, eliminating the need for the framer to insulate a closed cavity before the sheathing goes on.

**Limitations:** Drywall clips are unfamiliar to some builders and subcontractors. Exterior corner trim or cladding may result in being secured to the sheathing only and not to the stud.

**Code/Regulatory:** More studs may be required at corners in high-wind or earthquake zone construction.

**Availability:** Drywall clips are readily available.

## DOUBLING THE RIM JOIST IN LIEU OF HEADER (2x6 or wider wall construction)

**Details:** In thick wall construction, 5 1/2-inch or greater actual wall dimension, it is possible to have the floor system rim board act as the header, or one member of a two-ply girder or header assembly, at the door or window openings located below that member.

**Installation:** The joists that frame into this structural member will be shorter than other joists if the design requires a two-ply member to carry the span across the opening. Multiple-member headers should be properly fastened to assure load sharing.

**Benefits/Costs:** Some labor may be saved in framing the header, but extra labor and thought are involved in fitting perpendicular joists inside the two-ply assembly and framing the opening height down. The concept works best for long spans where the extra depth of the member or additional height of the opening is needed. The design is also an efficient method for use above openings in foundations.

**Limitations:** If the rim joist is intended to act along with the extra member (or by itself), it must be continuous across the opening.

**Code/Regulatory:** This is an unusual technique and may inspire questions from the inspector.

**Resources:**

- NAHB Research Center, *Advanced Framing Techniques: Optimum Value Engineering*, [www.nahbrc.org/tertiaryR.asp?TrackID=&DocumentID=2021&CategoryID=70](http://www.nahbrc.org/tertiaryR.asp?TrackID=&DocumentID=2021&CategoryID=70)
- HUDUSER, *Prescriptive Method for Residential Cold-Formed Steel Framing*, [www.huduser.org/publications/destech/pm2.html](http://www.huduser.org/publications/destech/pm2.html)
- Building American, DOE, *Optimum Value Engineering Best Practices*, (September, 2002), [www.ibacos.com/pubs/OptimumValueEngineering.pdf](http://www.ibacos.com/pubs/OptimumValueEngineering.pdf)
- DOE, *Advanced Framing for Walls and Ceilings*, [www.energy.state.or.us/code/respub/res10.pdf](http://www.energy.state.or.us/code/respub/res10.pdf)
- International Code Conference, *2003 International Residential Code®*, Panel Box Headers, Table R602.7.2, pg. 123, and Fig. R602.7.2, pg. 124

**2.1.3 Use building dimensions and layouts that maximize the use of the resources without the need to cut materials.****Intent:**

Use of standard or modular dimensions in layout will reduce waste by not having to cut materials.

**Information / How to Implement:**

Modular dimensioning was adopted in the late 1960s and is widely used. Adherence to modular dimensioning can reduce waste of material on the job site.

- One side of a door and window opening located at regular 16-inch or 24-inch stud positions.
- Modular window sizes used, with both side studs located at normal 16-inch or 24-inch stud positions.
- Building dimension in the direction parallel to the primary joist span is evenly divisible by four feet.
- Building dimension in the direction perpendicular to the primary joist span is evenly divisible by two feet.

Building to a 2-foot module and using 24-inch on-center wall and floor framing will maximize framing material resource efficiency and cost savings. Few homes can be entirely confined to a rigid module because typical dimensions such as the width of a tub or corridor are not in two-foot modules. To maximize savings, window sizes and placement should be coordinated with the two-foot module.

**Resources:**

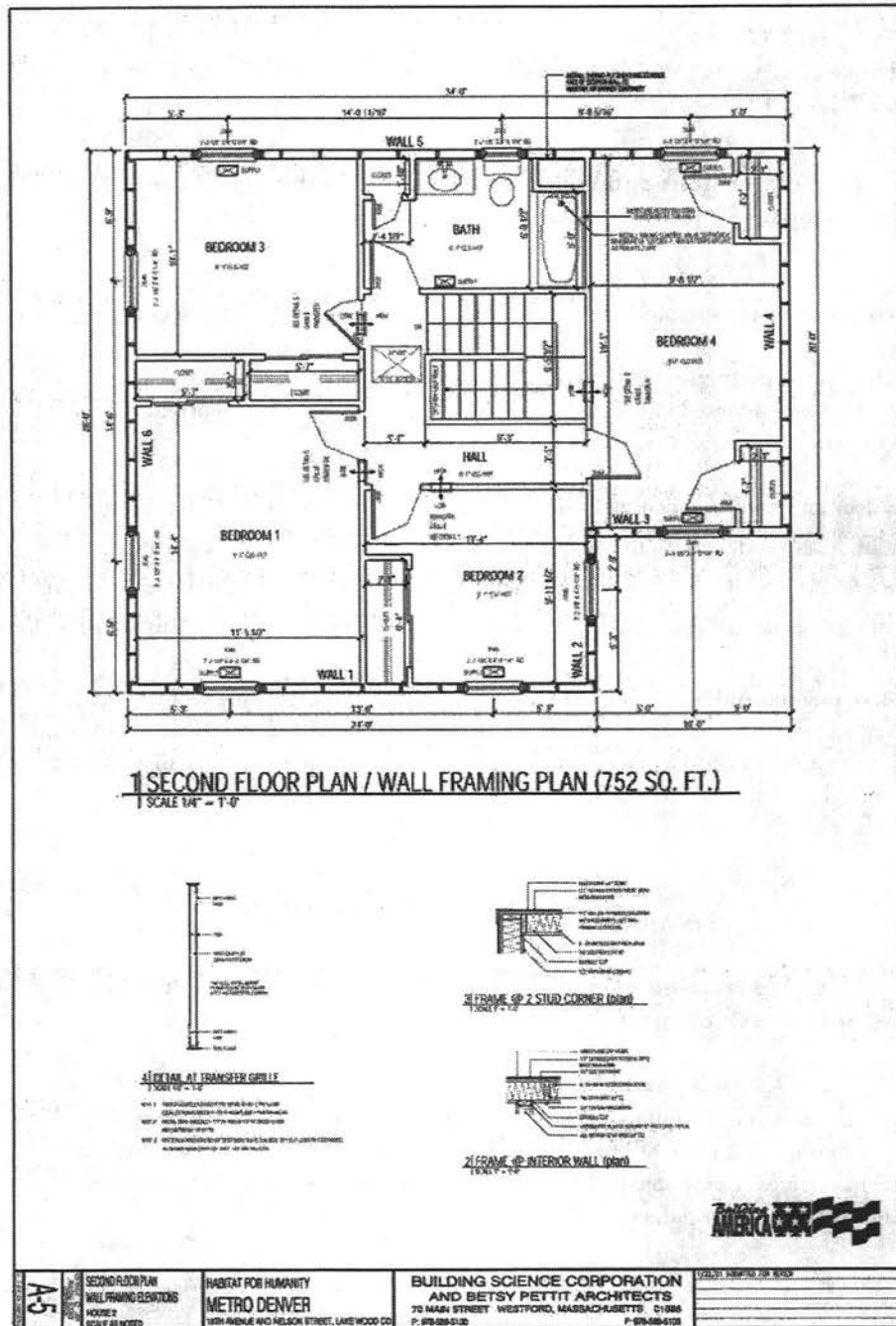
NAHB Research Center, PATH technology list, *Advanced Framing Techniques: Optimum Value Engineering (OVE)*, [www.toolbase.org/tertiaryT.asp?TrackID=&DocumentID=2021&CategoryID=70](http://www.toolbase.org/tertiaryT.asp?TrackID=&DocumentID=2021&CategoryID=70)

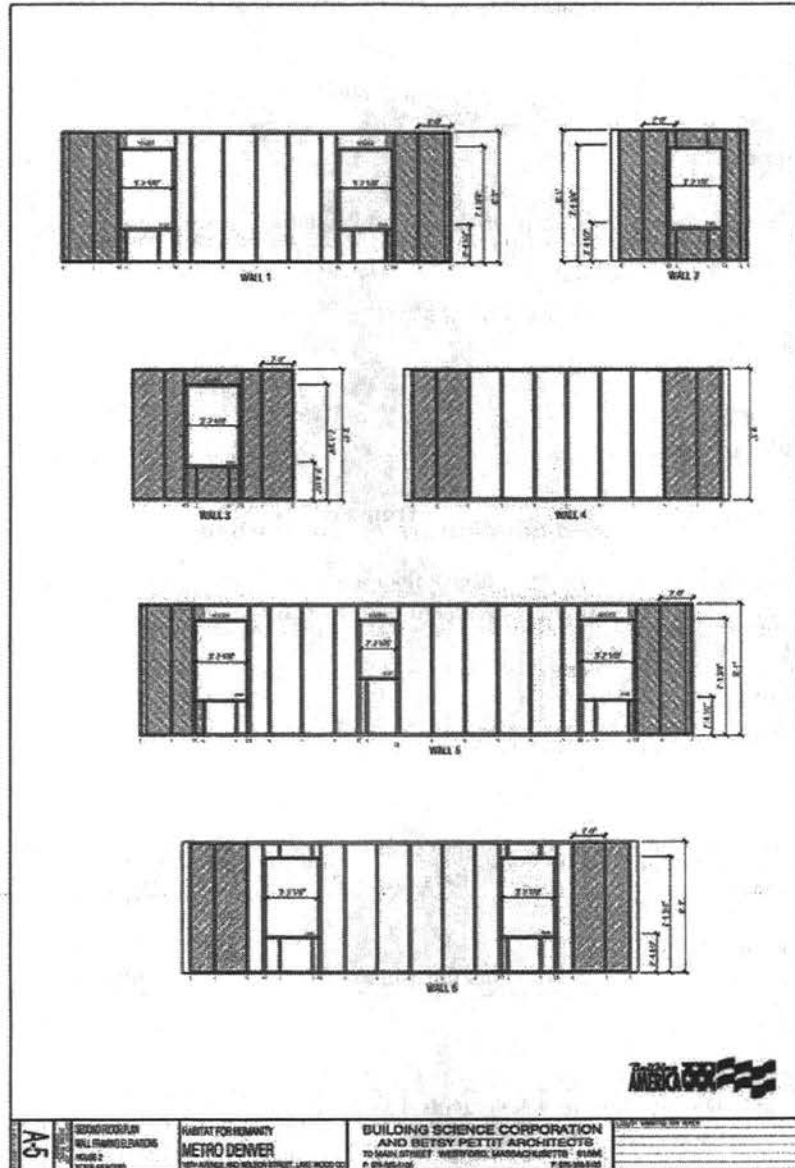
**2.1.4 Create a detailed framing plan and detailed material takeoffs. Provide an onsite cut list for all framing and sheathing material.****Intent:**

Recognize the benefits of careful planning in the design, purchase, and installation phases. A framing plan provides a blueprint for the layout of each piece of lumber. A plan eliminates redundant (off-layout) studs at window openings or joists at stair and mechanical chase openings that can act as thermal bridges. The layout provides an accurate count for generating a bill of materials that reduces job-site waste.

### Information / How to Implement:

A detailed framing plan can be as complex as a three-dimensional perspective generated in a computer-assisted-design (CAD) program or as simple as a one-eighth-inch scale drawing detailing the floor, wall, roof, lumber, or component layout, dimensions for rough opening(s), headers and girders, and blocking locations. The following pages show examples of a wall framing plan using advanced framing techniques.





### **2.1.5. Use building materials that require no additional finish resources to complete application onsite.**

#### **Intent:**

Materials that do not require additional finish resources save on priming, painting, and/or additional resources at the installation stage. Additionally, fewer resources are needed for recurring maintenance.

#### **Information / How to Implement:**

Ask manufacturer or installer whether a product requires any additional finish.

Examples (not an exhaustive list):

- Pigmented and stamped concrete-surfaced interior floors (of a slab-on-grade foundation).
- Exterior trim not requiring paint or stain.
- Windows with finished surfaces not requiring paint or stain.
- Siding not requiring paint or stain.

#### **Resources:**

Information will be added in Version 2.

### **2.1.6 Use pre-cut or pre-assembled building systems or methods.**

- A. Provide a pre-cut (joist) or pre-manufactured (truss) floor and roof framing package (points provided for a flooring or roof framing package—additional points provided if both packages are done).
- B. Provide a panelized wall framing system.
- C. Provide a panelized roof system.
- D. Provide modular construction for the entire house.

#### **Intent:**

Utilizing materials that do not require additional resources and/or onsite assembly optimizes plant manufacturing efficiencies and offers protection from the elements. Less time (site impact) and resources are spent onsite.

#### **Information / How to Implement:**

For Option A, the builder would receive three points for using a flooring package, three points for a roof framing package, or six points for using both.

**Pre-cut material packages**—A pre-cut floor or roof package can be bundled and shipped for sequencing of use in layout and covered to minimize exposure to the elements. Pieces are marked by location on a layout plan that is provided on the blueprint or with the package. Package delivery can be scheduled for just-in-time delivery to minimize site disturbance. Not having to cut or calculate the position of the components of the floor system speeds assembly, eliminates onsite waste, and saves labor. Contractor-focused lumberyards and component manufacturers that supply engineered wood will have the resources to provide this value-added service. Another resource is building material supply dealers that supply steel stud framing packages.

**Pre-manufactured component packages**—Open-web floor or roof truss packages also benefit from the efficiencies listed above for pre-cut material packages. Because building components can be engineered with 2x4 and 2x6 lumber to perform as capably as wide-dimension lumber, components present an opportunity to reduce the resources in a home. Often, the reduced amount of board feet of lumber in the component facilitates easier handling because of the reduced weight.

**Panelized construction**—Open wall panels manufactured in a factory benefit from efficient purchasing and use of materials, automated cutting and fastening methods, and assembly in an environment that is protected from the elements. Panels are custom manufactured and delivered to meet the builder's schedule. A layout plan aids the carpenter in assembling the walls onsite. Using panels can save several days in the critical path of assembly and speed the process of “closing in” the home.

**Modular construction**—Entire sections of the home are constructed and transported to the site. Modular housing goes further in reducing waste onsite, since the unit is delivered to the site 70 to 85% finished. Modules are moved onto a site-built foundation, connected, repaired at common junctions, and tied in to utilities. Homes can be made ready for move-in within one week.

**Resources:**

- NAHB, Building Systems Council, Fast Facts: Systems-Built Housing, [www.nahb.org/generic.aspx?sectionID=455&genericContentID=10216](http://www.nahb.org/generic.aspx?sectionID=455&genericContentID=10216) and [www.buildingsystems.org](http://www.buildingsystems.org)
- U.S. HUD, Builders' Guide to Residential Steel Floors, [www.huduser.org/Publications/PDF/steelfloor.pdf](http://www.huduser.org/Publications/PDF/steelfloor.pdf)

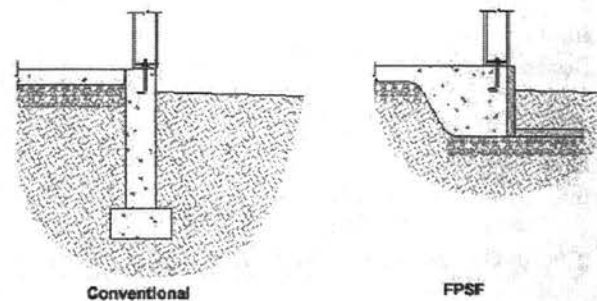
### 2.1.7 Install a frost-protected shallow foundation (FPSF).

**Intent:**

Minimize the excavation and site disturbance for foundations. Frost-protected shallow foundations use fewer materials than conventional foundations.

**Information / How to Implement:**

An FPSF incorporates strategically placed insulation to raise soil temperature and the frost depth around a building, thereby allowing foundation depths as shallow as 16 inches for almost all areas of the continental United States. Model codes have recognized frost-protected shallow foundation design principles since 1995. Performance has been proven in cold climates like Scandinavia, where FPSFs have been installed for the past 75 years.



**Resources:**

- NAHB Research Center, Revised Guide to Frost-Protected Shallow Foundations [www.toolbase.org/docs/SubsystemNav/Foundations/4495\\_RevisedFPSFGuide.pdf](http://www.toolbase.org/docs/SubsystemNav/Foundations/4495_RevisedFPSFGuide.pdf)

## 2.2 ENHANCE DURABILITY AND REDUCE MAINTENANCE

**Intent:**

Building designs, material choices, and installation techniques should seek to minimize the effects of degradation and weathering, enhance life expectancy of the assembly, and lessen maintenance needs.

**Information / How to Implement:**

Durability may be defined as the ability of a material, product, or building to maintain its intended function for its intended life expectancy with intended levels of maintenance in intended conditions of use.

Fortunately, many of the best practices meant to improve durability require little more than good judgment and a basic knowledge of the factors that affect building durability. A thorough review of resource publications will provide a solid foundation.

**Resources:**

- NAHB Research Center for PATH, Durability by Design, [www.huduser.org/publications/destech/durdesign.html](http://www.huduser.org/publications/destech/durdesign.html)
- Canadian Architect, *Measures of Sustainability*, [www.cdnarchitect.com/asf/perspectives\\_sustainability/measures\\_of\\_sustainability/measures\\_of\\_sustainability\\_durability.htm](http://www.cdnarchitect.com/asf/perspectives_sustainability/measures_of_sustainability/measures_of_sustainability_durability.htm)
- The Residential Moisture Management Network is working on addressing issues related to moisture management in homes, [www.rmmn.org/](http://www.rmmn.org/)
- Installation details for wood framed construction that will minimize moisture intrusion into the building envelope can be found at [www.buildabetterhome.org](http://www.buildabetterhome.org). Publications on foundations, roofs, and walls can be downloaded by going to each of those sections under the “builder tips” and then clicking on “get the brochure.”

**2.2.1 Provide a covered entry (e.g., awning, covered porch) at exterior doors to prevent water intrusion and subsequent rotting of joists, sills, and finishes.****Intent:**

A roof over an entry to a home sheds precipitation and keeps sunlight from the opening, protecting the door finish and penetration of moisture around jambs, trim and threshold, minimizing the need for maintenance of these areas. Roofs over entries also are convenient for the occupant during foul weather and are an architectural feature that can enhance a home’s visual appeal and provide an outdoor living space.

**Information / How to Implement:**

Designs should include a roof or recessed front opening of a depth equal to or greater than the recommended roof overhang for the region.

**Resources:**

Information will be added in Version 2.

**2.2.2. Use recommended-sized roof overhangs for the climate.****Intent:**

Protect the building envelope and enhance the home’s durability through the use of overhangs. Use overhangs to shade windows from summer heat gain.

**Information / How to Implement:**

The following table presents the recommended roof eave and rake overhangs for varying the climates:

**RECOMMENDED MINIMUM ROOF OVERHANG WIDTHS FOR ONE- AND TWO-STORY WOOD FRAME BUILDINGS\***

| Climate Index (see map below) | Eave Overhang (inches) | Rake Overhang (inches) |
|-------------------------------|------------------------|------------------------|
| Less than 20                  | N/A                    | N/A                    |
| 21 to 40                      | 12                     | 12                     |
| 41 to 70                      | 18                     | 12                     |
| More than 70                  | 24 or more             | 12 or more             |

**Source:** Modification of Prevention and Control of Decay in Homes by Arthur F. Verrall and Terry L. Amburgey, prepared for the U.S. Department of Agriculture and U.S. Department of Housing and Urban Development, Washington, DC, 1978.

\* Table based on typical two-story home with vinyl or similar lap siding. Larger overhangs should be considered for taller buildings or wall systems susceptible to water penetration and rot.

**Resources:**

- NAHB Research Center for PATH, Durability by Design, [www.huduser.org/publications/destech/durdesign.html](http://www.huduser.org/publications/destech/durdesign.html)

**2.2.3. Install perimeter drain for all basement footings sloped to discharge to daylight, dry well, or sump pit.**

**Intent:**

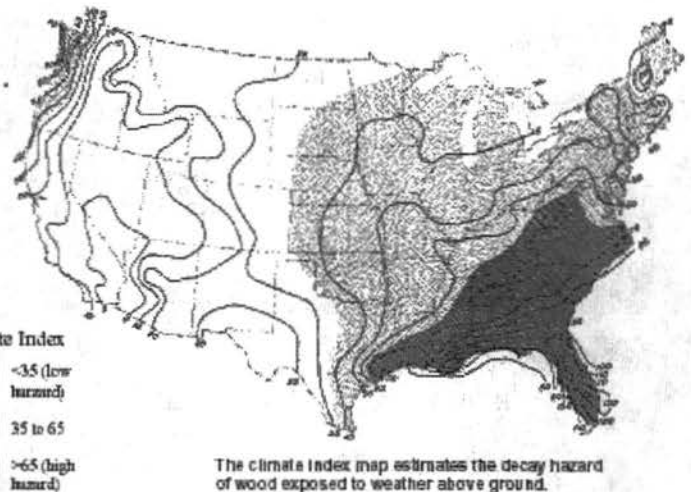
Divert surface and subsurface water away from the house, and limit water seepage through the foundation walls and basement slab.

**Information / How to Implement:**

A perimeter footing drain system of perforated pipe should be installed below the level of the basement slab on the inside and outside of the foundation wall and interconnected. Pipe should be wrapped with filter fabric and surrounded with a prescribed minimum of (IRC® 12 inches x 6 inches, exterior) clean gravel or crushed stone. If the outfall is to a sump pit, and the pit requires mechanical removal, pipe should be installed for outfall 10 feet away from foundation wall that does not cause localized erosion.

**Resources:**

Information will be added in Version 2.



**2.2.4. Install drip edge at eave and gable roof edges.**

**Intent:**

The drip edge directs roof runoff water into the gutters and away from the fascia and roof sheathing.

**Information / How to Implement:**

Drip edge is an inexpensive accessory that can be included in the roofer's scope of work and roofing material package.

**Resources:**

- Truini, Joseph, This Old House, Roof Runoff Remedy, [www.thisoldhouse.com/toh/knowhow/solutions/article/0,16417,193154,00.html](http://www.thisoldhouse.com/toh/knowhow/solutions/article/0,16417,193154,00.html)

**2.2.5. Install gutter and downspout system to divert water at least five feet away from foundation and into the overall onsite drainage area.**

**Intent:**

Moisture intrusion of foundations is avoided by moving runoff water beyond the foundation.

**Information / How to Implement:**

Storm water can be diverted from the roof and into a rain garden. Such a technique can help beautify the yard, reduce the amount of mowing needed, and reduce the need to use potable water for watering.

**Resources:**

Information will be added in Version 2.

**2.2.6 Divert surface water from all sides of building. Slope top of backfill to achieve settled slope of at least six inches of fall within 10 feet of the foundation walls.****Intent:**

Moisture intrusion of foundations is avoided by moving runoff water beyond the foundation.

**Resources:**

Steven Winter Assoc., Inc. for HUD, Volume 1 Rehab Guide: Foundations, Chapter 4, [www.toolbase.org/docs/SubsystemNav/Foundations/4406\\_rehab1\\_found.pdf](http://www.toolbase.org/docs/SubsystemNav/Foundations/4406_rehab1_found.pdf)

**2.2.7. Install a continuous and physical foundation termite barrier in areas where subterranean termite infestation is a problem.****Intent:**

Providing a non-chemical termite obstruction offers a long-term solution to termite infestation avoidance.

**Information / How to Implement:**

IRC Fig. R 301.2(6) has a Termite Infestation Probability Map of the United States dividing the country into different zones of infestation levels; heavy, moderate to heavy, etc. The local HBA may offer information on the regional probability of termite infestation in consultation with the cooperative extension service and other termite experts.

Using a foundation termite shield is only one way a builder can effectively combat infestation. Following is a breakdown of the home building process and a list of the tactics that can be used in an environmentally aware fashion to accomplish termite resistance.

**I. Site.**

- A. Selection—termites dislike dry conditions. Choose a site that is well-drained and ventilated.
- B. Sanitation—the majority of termites that infest homes live underground, and food (cellulose in the form of wood, paper, leaves, etc.) stored underground may lead termites to a house. When preparing a site for construction, don't bury vegetation and construction debris. After the foundation is built, don't include wood scraps in the backfill.
- C. Landscaping—Keep homes dry. Slope finish grade away from the house. Keep plantings well away from homes. Roots act as underground bridges through chemical or physical termite barriers. Plants such as shrubs and trees can prevent ventilation to the home and prevent drying after precipitation events.

**II. Design**

- A. Layout—Keep houses dry. Ensure that wood elements are stopped at least eight inches above finish grade. Termites can form hills or tubes that extend from the soil to food. Greater clearance between ground and wood elements prevents this situation and allows more time for detection should termites use tubes to reach above-ground food sources. Keep untreated wood away from contact with concrete. Concrete is a good conductor of water, and untreated wood in contact with concrete may decay or attract termites.
- B. Thermal—Termites love moisture and moisture comes from many sources. Proper design of the exterior envelope will prevent condensation from occurring.

- C. **Materials**—Areas of the home that are particularly susceptible to moisture, like shower and bath surrounds, should not be detailed with cellulose materials. Penetrations through the foundation, walls, and roof are all vulnerable to moisture intrusion, and care should be taken to minimize them. To protect against foundation penetrations, consider using one of new physical barriers in the marketplace. Termiticides bonded between a polymer fabric and a stainless-steel mesh small enough to keep out termites are some of the innovations available.

### III. Construction Process

- A. **Material Storage**—Keep moisture-sensitive materials dry, and don't incorporate compromised products into the house. Arrange to have materials delivered as close to the time of installation as practical.
- B. **Flashing**—Penetrations through the exterior envelope are particularly vulnerable to moisture intrusion. Properly flash and seal all penetrations to prevent moisture accumulation.

### IV. Post Construction

- A. **Owner Education**—Inform homeowners about the value of dry homes and practices they can perform to keep the house free of termites and decay. Describe prevention features of the home and how these features can become compromised.
- B. **Termite Control**—Should termites need subsequent control, consider targeted poisons such as baits.

#### Resources:

- Canadian Wood Council, Termite Control and Wood-Frame Buildings: Slab and Foundation Details, [www.cwc.ca/publications/building\\_performance/termites/structural.php](http://www.cwc.ca/publications/building_performance/termites/structural.php)
- NAHB Research Center, Termite Baiting [www.toolbase.org/tertiaryT.asp?TrackID=&CategoryID=1402&DocumentID=2153](http://www.toolbase.org/tertiaryT.asp?TrackID=&CategoryID=1402&DocumentID=2153)
- University of Kentucky Entomology, Termite Baits: A Guide for Homeowners, [www.uky.edu/Agriculture/Entomology/entfacts/struct/ef639.htm](http://www.uky.edu/Agriculture/Entomology/entfacts/struct/ef639.htm)
- Termiticide fabric and mesh manufacturers, [www.impasse.com/](http://www.impasse.com/) and <http://www.termi-mesh.com/>

#### **2.2.8. Use termite-resistant materials for walls, floor joists, trusses, exterior decks, and other exterior wood in regions known to be termite infested.**

##### Intent:

By eliminating the cellulose food source for termites or by repelling termites, the home's durability is enhanced.

##### Information / How to Implement:

Use the IRC® infestation map referenced in Section 2.2.7 to determine the probability of infestation for the region. Termite-resistant materials include naturally pest-resistant species of wood (e.g., redwood, cedar, white oak, black locust), treated wood (borate or ground contact solutions), masonry, steel, and concrete.

Reduce humidity in crawl spaces. Keep shrubs, vines, and other vegetation from growing over ventilation openings. Never bury wood scraps or waste lumber in the yard. Remove old tree stumps and roots around and beneath the building. Inform the homeowner to keep firewood piles away from the house, raised off the ground, and covered.

#### Resources:

- Durable-Wood.com, Forintek Canada Corp., Termite Control and Wood-Frame Buildings [durable-wood.com/termites/termitecontrol-e.pdf](http://durable-wood.com/termites/termitecontrol-e.pdf)
- Western Wood Preservers Institute, [www.wwpinstitute.org](http://www.wwpinstitute.org)
- *Terminate the Termites*, [www.steelframingalliance.com](http://www.steelframingalliance.com)

### **2.2.9 Provide a weather-resistant barrier (WRB) or a drainage plane system behind the exterior veneer system or the exterior siding.**

#### **Intent:**

To protect the building envelope from water intrusion by installing a secondary, exterior-wall water management system.

#### **Information / How to Implement:**

Wind-driven rain and air pressure differentials allow water intrusion into and behind most exterior claddings and veneers. A comprehensive approach to water management prevents water from reaching the sheathing or framing. Primary water management strategies include water-shedding architectural features such as overhangs and exterior claddings. Secondary (redundant) water management to protect the sheathing and framing from moisture damage can be in the form of a weather-resistive barrier, a distinct drainage plane, or both.

As part of a whole-wall design, weather-resistant barriers need to be integrated with other wall system components, including structure, insulation, vapor retarder, air retarder (if separate), and flashing systems.

#### **Resources:**

- NAHB Research Center, Weather-Resistant Barriers.  
[www.toolbase.org/docs/MainNav/MoistureandLeaks/3950\\_weatherresistantbarriers.pdf](http://www.toolbase.org/docs/MainNav/MoistureandLeaks/3950_weatherresistantbarriers.pdf)

### **2.2.10. Install ice flashing at roof edge.**

#### **Intent:**

The eave edges of a roof are particularly susceptible to water intrusion from wind-driven rain, clogged gutter backup, and freeze-thaw cycles after winter snowfalls. Ice barrier or flashing is a redundant barrier that protects the sheathing near the roof edges and keeps water out of the attic and walls.

#### **Information / How to Implement:**

The IRC® requires that, in areas where the average daily temperature in January is 25°F or less, an ice barrier consisting of at least two layers of underlayment cemented together or a self-adhering polymer modified bitumen sheet that extends from the edge of the eave to a point at least 24 inches inside the exterior wall line of the building be installed. It is recommended that the ice barrier approach be used for green home construction because the redundant protection provided by an ice-barrier is effective against many weather phenomena such as rain storms with high winds and winter snow.

#### **Resources:**

- University of Minnesota Extension Service, Ice Dams.  
[www.extension.umn.edu/distribution/housingandclothing/DK1068.html](http://www.extension.umn.edu/distribution/housingandclothing/DK1068.html)

### **2.2.11 Install enhanced foundation waterproofing.**

#### **Intent:**

To keep moisture out of the foundation by providing a waterproof exterior coating or engineered exterior drainage plane.

#### **Information / How to Implement:**

Foundation coatings that are required by the model building codes help prevent moisture from penetrating the foundation. A number of products are available to provide a more permanent barrier to moisture at the exterior of the foundation.

**Resources:**

- ToolBase Services, Foundation Drainage Panels, [www.toolbase.org/tertiaryT.asp?TrackID=&DocumentID=2063&CategoryID=1010](http://www.toolbase.org/tertiaryT.asp?TrackID=&DocumentID=2063&CategoryID=1010)

**2.2.12 Employ and show on plans the following flashing details:**

- Around windows and doors,
- Valleys,
- Deck/house juncture,
- Roof/wall junctures, chimney step flashing, and
- Drip cap above windows and doors.

**Intent:**

To specify and call out the details of systems integration on the blueprints rather than leaving them to the half dozen or so specialists who perform installation of adjacent materials on the jobsite. All junctions of dissimilar material and flashing details are to be shown on plans.

**Information / How to Implement:**

Product manufacturer's installation guides and association best practices details are good sources for the correct detailing of systems.

**Resources:**

- Brick, [www.gobrick.com/html/frmset\\_thnt.htm](http://www.gobrick.com/html/frmset_thnt.htm)
- Masonry products, [www.ncma.org](http://www.ncma.org)
- Various, <http://pix.nrel.gov:8020/BASIS/nich/www/bapublic/SDF>
- Windows and doors, <http://pix.nrel.gov:8020/BASIS/nich/www/bapublic/SDF>
- Wood, <http://apacad.org/>
- *EEBA Water Management Guide*—[www.eeba.org/mall/water.asp](http://www.eeba.org/mall/water.asp)—This guide presents a variety of ways to minimize water intrusion into homes. These recommendations are not intended to apply to every conceivable situation but are intended to illustrate principles.

**2.3 REUSE MATERIALS****2.3.1 Disassemble existing buildings (deconstruction) instead of demolishing.****Intent:**

Construction activities may comprise as much as 40% of all raw materials extracted from the earth. At the same time, construction, remodeling, and deconstruction are blamed for generating 136 million tons of waste annually. Some waste material can easily be refitted into a structure. The action decreases both material use and waste. In addition, unneeded transportation costs associated with hauling can be eliminated.

**Information / How to Implement:**

Develop and implement a plan to use materials prudently, regardless of their origination.

**Resources:**

- Inform, Inc., *Community Waste Prevention Toolkit: Construction and Demolition Fact Sheet*, [www.informinc.org/fact\\_CWPconstruction.php#basics](http://www.informinc.org/fact_CWPconstruction.php#basics)
- Government of Hawaii, *Minimizing Construction and Demolition Waste*, [www.hawaii.gov/health/environmental/waste/sw/pdf/constdem.pdf](http://www.hawaii.gov/health/environmental/waste/sw/pdf/constdem.pdf)
- California Integrated Waste Management Board (CIWMB), [www.ciwmb.ca.gov](http://www.ciwmb.ca.gov)
- CIWMB, *Recycled-Content Product Directory*, [www.ciwmb.ca.gov/RCP/Product.asp?VW=CSI&CATID=269](http://www.ciwmb.ca.gov/RCP/Product.asp?VW=CSI&CATID=269)
- NAHB Research Center, ToolBase Services, *Construction Waste Management*, [www.toolbase.org/secondaryT.asp?TrackID=&CategoryID=34](http://www.toolbase.org/secondaryT.asp?TrackID=&CategoryID=34)
- Whole Building Design Guide, *Construction Waste Management Database*, [www.wbdg.org/ccbref/cwm.php](http://www.wbdg.org/ccbref/cwm.php)
- Washington State Department of General Administration, *Construction Waste Management Guide*, [www.ga.wa.gov/EAS/CWM/ContractorsGuide.doc](http://www.ga.wa.gov/EAS/CWM/ContractorsGuide.doc)

**2.3.2 Reuse salvaged materials, where possible.****Intent:**

To minimize the waste stream by reusing materials. Ideally, salvaged materials should be reclaimed from a nearby or onsite demolition or remodeling project to minimize transportation.

**Information / How to Implement:**

Note: Building materials can come from the deconstructed building in 2.3.1 or from another source.

Note—The word “component” is used in certain line items in this section (2.3.2; 2.4.1; 2.5.3; 2.6.1; 2.6.2; 2.7.1; and 2.8.1). A component is defined as part of an entire building system, such as:

- |                       |                    |                 |
|-----------------------|--------------------|-----------------|
| • footing             | • wall sheathing   | • interior trim |
| • foundation walls    | • roof sheathing   | • flooring trim |
| • slab                | • wall insulation  | • finish trim   |
| • floor framing       | • attic insulation | • siding        |
| • interior partitions | • windows          | • other.        |
| • wall framing        | • interior doors   |                 |
| • roof framing        | • exterior doors   |                 |

Salvaged materials can be used for fill material, base for paved areas, or within building(s). Materials include crushed concrete, salvaged wood, steel, brick, and architectural materials such as windows, doors, paneling, and cabinets.

Salvaged windows and exterior doors should not be used at the expense of energy efficiency.

**Disclaimer**—Salvaged materials must meet minimum standards where applicable. Be careful of lead paint and other potentially hazardous finishes that could be part of existing materials.

Points can be provided if the total cost of the salvaged materials (including material costs and labor costs, i.e., installed costs) is equal to or greater than 1% of construction costs.

**Resources:**

- Jennifer Corson, *The Resourceful Renovator: A Gallery of Ideas for Reusing Building Materials* (Chelsea Green Publishing Company, December 2000)

- Greater Vancouver Regional District Policy and Planning Department, *Old to New Design Guide Salvaged Building Materials in New Construction* 3rd Edition (January 2002), [www.buildsmart.ca/pdfs/DesignGuideMaster.pdf](http://www.buildsmart.ca/pdfs/DesignGuideMaster.pdf)
- Used Building Materials Association, <http://bcn.boulder.co.us/environment/ubma/index.html>

### **2.3.3 Dedicate and provide onsite bins and/or space to facilitate the sorting and reuse of scrap building materials.**

#### **Intent:**

This practice will establish a central storage area to encourage maximizing usage of all materials on the site. Workers are less likely to waste material that will be subject to future inspection. Those same workers are more likely to seek and use scraps if they know where to find them quickly and the remnants that were not incorporated into the job are already sorted for grinding or recycling.

#### **Information / How to Implement:**

Information will be added in Version 2.

#### **Resources**

Scopes of work should include the removal of remnants to a designated central area. The reuse area should be conveniently located and marked or delineated for the size, type, and quantity of material expected.

## **2.4 USE RECYCLED-CONTENT MATERIALS**

### **2.4.1 Use recycled-content building materials.**

#### **Intent:**

To minimize the impact of home building on the environment.

#### **Information / How to Implement:**

Points: To obtain the three points, the project must have a minimum of two types of recycled-content materials. Each type of recycled-content material used thereafter would give the project another point each, to a maximum of six points.

A builder can obtain three points by incorporating at least two different types of recycled-content building materials into the home's construction. An additional point is awarded for each additional type of material for a maximum point total of five points.

Post-consumer means that the materials have been used by a consumer. Post-industrial can include waste materials from within a manufacturing site that are fed back into the manufacturing process as feedstock *and* materials from outside the plant that are waste elsewhere, have not gone to a landfill or consumer yet, but are incorporated into a product's manufacturing process (e.g., fly ash for concrete).

The results of a California Integrated Waste Management Board (CIWMB) study on building material emissions indicate that recycled-content products perform about the same as standard products. Both alternative and standard products have the potential to emit chemicals of concern. For a copy of the study, see [www.ciwmb.ca.gov/Publications/GreenBuilding/43303015.doc](http://www.ciwmb.ca.gov/Publications/GreenBuilding/43303015.doc).

Here are some typical ranges of recycled content found in various construction materials:

Clay brick is manufactured with a variety of recycled materials. Examples include contaminated soils, scrap soils from excavations, inclusion of bottom ash from coal-fired generators, and production scrap from other ceramic products. The amount of recycled materials in clay brick depends on the type of material added, but typical values range up to 7% by weight.

Through the Composite Panel Association's Environmentally Preferable Product (EPP) Specification CPA 1-02, composite panels (particleboard, medium-density fiberboard [MDF], and hardboard) can be certified to have 100% recycled or recovered fiber. See the Resources section of this line item for further information.

Cellulose insulation can contain as much as 85% recycled paper stock (wood-based) content. Additionally, it is certified in accordance with ASTM 739 and the Cellulose Insulation Manufacturers Association.

Fiberglass insulation: 25% combination post- and pre-consumer recyclables

Steel framing: 25% of which no less than 10% should be post-consumer recycled

Carpeting: Recycled-content carpet is available for residential construction



Fly ash or slag: Fly ash or slag, by-products of the steel production process, can be used in concrete as a replacement for some of the cement. In some cases, as much as 40% of the cement can be substituted while maintaining required strength and durability. Many concrete suppliers are familiar with recycled-content options, and some have reported that the use of fly ash or slag is standard practice. Several contractors have reported that the fly ash-content concrete sets up more slowly, and adjustments must be made in the timing of finishing. Also, fly ash- or slag-content concrete may have some dark streaking and therefore, may not be suitable for exposed flatwork or poured walls. Check with your local concrete supplier.

Road and paver base, gravel: In many parts of the country, efforts are underway to recycle concrete waste. Concrete is ground into usable materials for temporary construction roads, a base for pavers or bricks, or other possible uses in place of limestone or gravel. In some cases, concrete suppliers have developed and tested mixes in which some recycled concrete is used. Check with local concrete suppliers or landfills to see if recycled concrete aggregate is available.

Check with local jurisdictions regarding recycling programs. The use of recyclable materials is also recommended. Products that are either recycled or recyclable will display the triangle logo (see above). The product literature must note the recycled content, if any. The reference section contains additional information on this.

#### Resources:

- King County (WA), *Environmentally Responsible Carpet Choices*, [www.metrokc.gov/procure/green/carpet.htm](http://www.metrokc.gov/procure/green/carpet.htm)
- U.S. Environmental Protection Agency (EPA), *Comprehensive Procurement Guidelines*, [www.epa.gov/cpg/](http://www.epa.gov/cpg/)
- EPA, *Environmentally Preferable Purchasing*, [www.epa.gov/oppt/epp/tools/toolsuite.htm](http://www.epa.gov/oppt/epp/tools/toolsuite.htm)
- Green Building Source, *Green Product Information* <http://oikos.com/products/index.lasso>
- California Integrated Waste Management Board, *Recycled Product Directory, Products Category: Construction*, can provide a baseline for total recycled content (TRC) that is achievable with some products, [www.ciwmb.ca.gov/RCP/Product.asp?VW=CAT&CATID=257](http://www.ciwmb.ca.gov/RCP/Product.asp?VW=CAT&CATID=257)
- Details on the Composite Panel Association's Environmentally Preferable Product (EPP) Specification CPA 1-02 and a list of certified manufacturers, [www.pbmdf.com/AboutCPA/EPP.asp](http://www.pbmdf.com/AboutCPA/EPP.asp)
- Carpet America Recovery EffortSM, [www.carpetrecovery.org/](http://www.carpetrecovery.org/)
- Steel Recycling Institute, [www.recycle-steel.org/construction.html](http://www.recycle-steel.org/construction.html)

Excerpt from the Federal Trade Commission's Part 260 —*GUIDES FOR THE USE OF ENVIRONMENTAL MARKETING CLAIMS*... (d) Recyclable: "It is deceptive to misrepresent, directly or by implication, that a product or package is recyclable. A product or package should not be marketed as recyclable unless it can be collected, separated or otherwise recovered from the solid waste stream for reuse, or in the manufacture or assembly of another package or product, through an established recycling program. Unqualified claims of recyclability for a product or package may be made if the entire product or package, excluding minor incidental components, is recyclable. For products or packages that are made of both recyclable and non-recyclable components, the recyclable claim should be adequately qualified to avoid consumer deception about which portions or components of the product or package are recyclable. Claims of recyclability should be qualified to the extent necessary to avoid consumer deception about any limited availability of recycling programs and collection sites. If an incidental component significantly limits the ability to recycle a product or package, a claim of recyclability would be deceptive. A product or package that is made from recyclable material, but, because of its shape, size or some other attribute, is not accepted in recycling programs for such material, should not be marketed as recyclable..."

Source: Federal Trade Commission, Part 260—Guides for the Use of Environmental Marketing Claims, [www.ftc.gov/bcp/gnrule/guides980427.htm](http://www.ftc.gov/bcp/gnrule/guides980427.htm)

## **2.5 RECYCLE WASTE MATERIALS DURING CONSTRUCTION**

Recycling waste materials is driven by market conditions at the local level. Recycling markets and tipping fees vary greatly.

### **2.5.1 Develop and implement a construction and demolition (C & D) waste management plan that is posted at job site.**

#### **Intent:**

Create a C & D waste management plan that sets goals to recycle or salvage a minimum of 50% (by weight) of construction, demolition, and land-clearing waste.

#### **Information / How to Implement:**

A C & D plan can be a simple spreadsheet that covers the materials used or deconstructed on site and the plan for reusing them onsite or recycling them. If recycling, include the name of the hauler, the destination, and approximate quantities. A sample plan can be obtained from the City of Oxnard, CA, in the Resources.

#### **Resources:**

- City of Oxnard (CA). *C & D Solid Waste Management and Recycling Plan*, [www.ci.oxnard.ca.us/pubworks/refuse/worksheets/c\\_dplan.pdf](http://www.ci.oxnard.ca.us/pubworks/refuse/worksheets/c_dplan.pdf)
- NAHB Research Center, Inc., Residential Construction Waste information, [www.epa.gov/epaoswer/non-hw/debris/mgmt.htm](http://www.epa.gov/epaoswer/non-hw/debris/mgmt.htm)
- U.S. Environmental Protection Agency Solid Waste and Emergency Response. *Building Savings, Strategies for Waste Reduction of Construction and Demolition Debris from Buildings* (EPA-530-F-00-001) (June 2000), [www.epa.gov/osw](http://www.epa.gov/osw)
- Institute for Local Self-Reliance. [www.ilsr.org/recycling/buildingdebris.pdf](http://www.ilsr.org/recycling/buildingdebris.pdf)

### **2.5.2. Conduct onsite recycling efforts, e.g., use grinder and apply materials onsite, thus reducing transportation-related costs.**

#### **Intent:**

Through grinding, divert from the landfill a minimum of 50% (by weight) of construction, demolition, and land-clearing waste. Reduce transportation-related environmental costs.

**Information/ How to Implement:**

This task may also be part of the builder C & D plan. Grinding and other methods of onsite processing and reuse of waste require an economic analysis. Large home builders have reported successful integration of a grinder into field operations. (See Waste Handling Equipment news article in References.) For small-volume builders, it not likely be cost effective to own or rent grinding equipment. There may, however, be a local business that could efficiently perform this service for a small job.

**Resources:**

- Waste Handling Equipment News, Major Home Builders Benefit from On-site Recycling, [www.wastehandling.com/july/major.html](http://www.wastehandling.com/july/major.html)
- NAHB Research Center, ToolBase Services, RESIDENTIAL CONSTRUCTION WASTE: FROM DISPOSAL TO MANAGEMENT, [www.toolbase.org/tertiaryT.asp?TrackID=&CategoryID=34&DocumentID=2301](http://www.toolbase.org/tertiaryT.asp?TrackID=&CategoryID=34&DocumentID=2301)

### **2.5.3 Recycle construction waste offsite, e.g., wood, cardboard, metals, drywall, plastics, asphalt roofing shingles, concrete, block, other.**

**Intent:**

Through a recycling program, divert from the landfill a minimum of 50% (by weight) of construction, demolition, and land clearing waste.

**Information/ How to Implement:**

At least two types of materials must be recycled to obtain the six points. Each type of material recycled thereafter yields two points each to a maximum of 12 points.

This task may also be part of the builder C & D plan.

**Resources:**

- The U.S. General Services Administration (GSA) has recently updated its online Construction Waste Management Database to assist the building industry in reducing construction and demolition waste. Recyclers of construction and demolition waste may advertise their services free on this site. Access the database at <http://cwm.wbdg.org>.
- American Forest and Paper Association, National Wood Recycling Directory, [www.afandpa.org/Content/NavigationMenu/Environment\\_and\\_Recycling/Recycling/Wood\\_Recovery1/Wood\\_Recycling\\_Directory1/Wood\\_Recycling\\_Directory\\_Intro.htm](http://www.afandpa.org/Content/NavigationMenu/Environment_and_Recycling/Recycling/Wood_Recovery1/Wood_Recycling_Directory1/Wood_Recycling_Directory_Intro.htm)
- California Integrated Waste Management Board, [www.ciwmb.ca.gov/](http://www.ciwmb.ca.gov/)
- Corrugated Packaging Council, How to Recycle Corrugated, <http://cpc.corrugated.org/Recycle/RecyHowTo.aspx>
- U.S. Environmental Protection Agency Municipal and Industrial Solid Waste Division Office of Solid Waste, Characterization of Building-Related Construction and Demolition Debris in the United States (EPA530-R-98-010) (June 1998), [www.epa.gov/epaoswer/hazwaste/sqg/c&d-rpt.pdf](http://www.epa.gov/epaoswer/hazwaste/sqg/c&d-rpt.pdf)
- Steel Recycling Database, [www.recycle-steel.org/database/main.html](http://www.recycle-steel.org/database/main.html)

## **2.6 USE RENEWABLE MATERIALS**

### **2.6.1 Use materials manufactured from renewable resources or agricultural by-products such as soy-based insulation, bamboo, or wood-based products.**

**Intent:**

Use building products that use carbon sequestration, i.e., that are made from plants that take carbon from the atmosphere and store it as fiber.

**Information / How to Implement:**

A builder can obtain three points for this line item by incorporating at least two different types of renewable resources into the home's construction. An additional point can be obtained for each additional type of material for a maximum total for this line item not to exceed five points.

Careful review of the material manufacturer's claims and material specifications is required for this task. Points should be given for each material specified and used.

Note: Products used should also comply with the Indoor Environmental Quality section of the User Guide. For example, composite wood or agrifiber panel products should not contain process-added urea-formaldehyde resins or must be third-party certified for low formaldehyde emissions. Particleboard, medium-density fiberboard (MDF), and hardwood plywood substrates must be certified to low formaldehyde emission standards ANSI A208.1, ANSI A208.2 and ANSI/HPVA HP1, respectively (see Section 5.1.5). Similarly, bamboo flooring manufacturers should produce a copy of the lab test results, by an American laboratory, for their products. The results should include a formaldehyde test and a hardness and stability (expansion/contraction) test.

**Resources:**

Information will be added in Version 2.

**2.6.2 Use certified wood for wood and wood-based materials and products from all credible third-party-certified sources.****Intent:**

Preserving our natural resources includes the commitment to best practices in forest management, like practices that maintain and restore their health and ecosystems. Forest certification systems help identify producers that assure a reliable supply without damaging forests.

**Information / How to Implement:**

A comparison list of the North American certifiers is provided by the Forest Certification Resource Center in the Resources section.

Below is a list of the third-party-certified wood sources.

- The Sustainable Forestry Initiative® Program
- The American Tree Farm System®
- The Canadian Standards Association's Sustainable Forest Management System Standards (CAN/CSA Z809)
- Forest Stewardship Council (FSC)
- Program for the Endorsement of Forest Certification Systems (PEFC), and
- Other such credible programs as they are developed and implemented.

**Resources:**

- Forest Certification Resource Center, *Comparison of Forest Certification Systems*, [www.certifiedwood.org/search-modules/compare-systems/comparison-of-systems/comparison-of\\_systems.htm](http://www.certifiedwood.org/search-modules/compare-systems/comparison-of-systems/comparison-of_systems.htm)
- The Sustainable Forestry Initiative® Program, [www.aboutsfi.org/](http://www.aboutsfi.org/)
- The American Tree Farm System® [www.treefarmssystem.org/](http://www.treefarmssystem.org/)
- The Canadian Standards Association's Sustainable Forest Management System Standards (CAN/CSA Z809) [www.sfms.com/welcome.htm](http://www.sfms.com/welcome.htm)
- Forest Stewardship Council (FSC) [www.fsc.org/fsc](http://www.fsc.org/fsc)
- Program for the Endorsement of Forest Certification Systems (PEFC) [www.pefc.org/internet/html](http://www.pefc.org/internet/html)

## 2.7 USE RESOURCE-EFFICIENT MATERIALS

### 2.7.1 Use products that contain fewer resources than traditional products.

**Intent:**

Minimize the resources consumed by and the environmental impact of building a house.

**Information / How to Implement:**

A project must use resource-efficient materials for at least two different types of components to receive the three points.

When specifying materials, consider the amount of resources going into the product and whether alternatives are available. Examples are specifying hollow brick that meets the requirements of ASTM C 652 and is made from less material than face brick meeting ASTM C 216. Appearance and durability requirements are identical. Or, specifying engineered-wood products, e.g., I-joists that use 35% less fiber material than solid-sawn products.

Caveat: Even though engineered products can reduce the amount of feedstock used in a product, e.g., wood fiber in I-joists, more energy or binders may be needed to create the final product. While this may be the case, our intent is to reduce the core source of material going into the product's creation.

**Resources:**

- DOE's Energy Efficiency and Renewable Energy, Energy and Environmental Guidelines for Construction, [www.eere.energy.gov/buildings/info/design/construction.html#construction](http://www.eere.energy.gov/buildings/info/design/construction.html#construction)

## 2.8 INNOVATIVE OPTIONS

### 2.8.1 Use locally available, indigenous materials.

**Intent:**

To make the home building process more environmentally acceptable by minimizing transportation and processing costs and using materials that are common to the local region.

**Information / How to Implement:**

A builder can obtain three points for this line item by incorporating at least one type of locally available, indigenous material into the home's construction. An additional point can be obtained for each additional type of material for a maximum point total of five points.

Guidance to program administrators: Points should be awarded in this section based on criteria such as 10% of the building materials are extracted, processed, and manufactured within a 300-mile radius or within a 1000-mile radius if shipped by rail, or a combination of the two distances.

**Resources:**

Information will be added in Version 2.

### 2.8.2 Use a life-cycle assessment (LCA) to compare the environmental burden/effects of building materials. Based on the analysis, choose the most environmentally preferable product for that building component.

**Intent:**

To highlight the best use of resources, including cost, to assure that all of the guiding principles have been considered.

**Information / How to Implement:**

A life cycle assessment (LCA) is a reliable way to calculate and compare the cradle-to-grave environmental effects and costs of common building materials. Designers can use modeling tools such as Athena™ to examine the life-cycle environmental effects of a complete structure or of individual assemblies, and can experiment with alternative designs and material mixes to arrive at the best environmental footprint. A software tool such as BEES ([www.bfrl.nist.gov/oae/software/bees.html](http://www.bfrl.nist.gov/oae/software/bees.html)) can also identify the life-cycle costs of select building components. The objective of the modeling is to aid the designer in selecting building assemblies and/or materials with the lowest reported impact in terms of energy consumption, air and water toxicity index, GWP, ecologically weighted resource use, and solid-waste emissions.

**Suggested course of action:**

1. Develop building design using materials with a low environmental impact. Evaluate building materials for each life-cycle phase using either the manufacturer's data or a reputable LCA.
2. Establish a process to compare and assess similar building materials in similar categories.
3. Survey manufacturers to analyze the environmental impacts at each phase of a product's life, making it possible to explore the environmental effects of design options or material mixes in order to arrive at the best green design.
4. Use the Athena™ tool to assess building assemblies.

**Another suggested two-step process:**

1. Conduct preliminary research and an evaluation of building materials generically, such as concrete, steel, and wood. Explore the environmental effects of different design options or material mixes.
2. Provide evidence that the selection of the foundations and floor assembly materials, structural system (column and beam, or post and beam combinations), roof and envelope assembly materials (cladding, windows etc.) included a life-cycle assessment.

**Resources:**

- National Institute of Standards and Technology, *Building for Environmental and Economic Sustainability software*, [www.bfrl.nist.gov/oae/software/bees.html](http://www.bfrl.nist.gov/oae/software/bees.html)
- The Athena™ Sustainable Materials Institute, [www.athenasmi.ca/news/download/LCI\\_Database\\_Project\\_News\\_1.pdf](http://www.athenasmi.ca/news/download/LCI_Database_Project_News_1.pdf)