Advanced Framing: Insulated Headers

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Scope

Construct framed walls using advanced framing details like insulated headers over windows and doors that reduce framing and thermal bridging and allow more space for insulation.

- Use pertinent code requirements to determine minimum header lumber requirements.
- Eliminate jack studs (also known as shoulder studs) on non-load-bearing walls and replace with metal hangers on load-bearing walls. Add 2x2 nailers as needed for siding attachment.
- On non-load-bearing walls, install open headers and insulate like wall cavities.
- On load-bearing walls, install an insulated header that meets minimum header strength requirements. Options include a prefabricated insulated header, a SIP header, or a header made of one piece of plywood plus rigid foam, or two pieces of plywood sandwiching rigid foam.
- ENERGY STAR requires that the header be insulated to at least R-3 in 2x4 framed wall assemblies or at least R-5 in thicker wall assemblies (e.g., 2x6 framing). (ENERGY STAR 2018).

See the Compliance Tab for related codes and standards requirements, and criteria to meet national programs such as DOE’s Zero Energy Ready Home program, ENERGY STAR Certified Homes, and Indoor airPLUS.
Description

In load-bearing exterior walls, structural headers are placed over windows and doors to pick up the load from the building above and transfer it to the posts on both sides of the window or door opening. Structural headers are a point of increased heat loss because they are made from solid or laminated framing timbers with no insulation. Proper sizing of headers allows better insulation and saves wood. Insulated headers reduce heat transfer to keep the home warmer in the winter and cooler in the summer.

In many cases, headers are overdesigned, consisting of solid wood layers that add up to the full 4- or 6-inch wall thickness. (For example, a header made of two 2x12s sandwiching a ½-inch layer of plywood is installed when a header comprised of thinner layers of plywood or OSB would provide enough structural strength and allow room for a layer of rigid foam.) In some cases, no solid wood layer is needed; in nonbearing walls, the header space can be left open and filled with insulation instead. Structural headers are not required in most interior walls or in gable-end walls with only non-bearing trusses directly above. A single flat 2x4 or 2x6 can be used as a header in interior or exterior non-bearing walls for openings up to 8 feet in width if the vertical distance to the parallel nailing surface above (usually the top plate) is not more than 24 inches. For such non-bearing headers, no cripples or blocking are required above the header. Insulated or open headers should be used except where a framing plan provided by the builder, architect, designer, or engineer indicates that full-depth solid headers are the only acceptable option. [See 2009 IRC Tables R502.5(1) and R502.5(2) for header span requirements.]

Insulated headers can be made of rigid foam sandwiched between two layers of plywood or OSB or one layer of foam and one layer of plywood, or structural insulated panels. These can be built onsite, or pre-fabricated insulated headers can be purchased.

Headers are installed by the framers using plans provided by the designer or architect. This task should be included in the contract for the appropriate trade depending on the workflow at the specific job site. High-performance branding programs and the IECC code require that builders meet specified insulation levels. See the “compliance” tab for these specified insulation levels.

Figure 1 - Structural headers are used above the windows on the bearing walls in this drawing but the wood layer is properly sized (no thicker than necessary) to allow for a layer of rigid insulation. On nonbearing walls, the headers are open allowing for the space above the windows to be insulated to the same level as the rest of the wall.

How to Install an Insulated Header on a Bearing Wall

1. Use pertinent code requirements to determine minimum header lumber requirements. [See for example, 2009 IRC R602.7 and Tables R502.5(1) and (2).] Install a properly sized prefabricated header or fabricate the header onsite from one piece of rigid foam and one or two pieces of plywood; see Figures 2 and 3.
2. Eliminate jack studs (also known as shoulder studs) on load-bearing walls by hanging structural headers with metal hangers instead. Note that jack studs are not needed on non-bearing walls. Eliminating jack studs will reduce the available nailing area for siding and trim if nailable sheathing (e.g., plywood or OSB) is not used. If needed, attach a 2x2 wood nailer to the outside edge of the stud for siding attachment.
How to Insulate a Header on a Non-Bearing Wall

Install a single flat 2x4 or 2x6 at the top of the door or window rough opening as the header in interior or exterior non-bearing walls for openings up to 8 feet in width if the vertical distance to the parallel nailing surface above (usually the top plate) is not more than 24 inches. For such non-bearing headers, no cripples or blocking are required above the header (2009 IRC R602.7.2). Insulate the cavity above the header in the same manner as the rest of the wall.

Figure 4 - Insulated headers can be hung with metal hangers instead of jack studs to reduce lumber usage.

Figure 5 - Structural headers are not needed on nonbearing walls; the open space above the window can be filled with the same insulation as the other wall cavities.
Ensuring Success

It may be possible to detect heat loss at the headers with an infrared camera, if a sufficient temperature difference exists between the outside and the conditioned space of the house. The quality of installation of the insulation should be visually inspected by the site supervisor before the drywall is installed.
Climate

No climate specific information applies.
Training

Right and Wrong Images

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Compliance

The Compliance tab contains both program and code information. Code language is excerpted and summarized below. For exact code language, refer to the applicable code, which may require purchase from the publisher. While we continually update our database, links may have changed since posting. Please contact our webmaster if you find broken links.

ENERGY STAR Certified Homes, Version 3/3.1 (Rev. 09)

National Rater Field Checklist

Thermal Enclosure System.
3. Reduced Thermal Bridging.
3.4.3b Headers above windows & doors insulated? R-3 for 2x4 framing or equivalent cavity width, and ? R-5 for all other assemblies (e.g., with 2x6 framing).23

Footnote 23) Compliance options include continuous rigid insulation sheathing, SIP headers, other prefabricated insulated headers, single-member or two-member headers with insulation either in between or on one side, or an equivalent assembly. R-value requirement refers to manufacturer’s nominal insulation value.

Please see the ENERGY STAR Certified Homes Implementation Timeline for the program version and revision currently applicable in your state.

DOE Zero Energy Ready Home (Revision 07)

Exhibit 1 Mandatory Requirements.
Exhibit 1, Item 1) Certified under the ENERGY STAR Qualified Homes Program or the ENERGY STAR Multifamily New Construction Program.
Exhibit 2, Item 2) Ceiling, wall, floor, and slab insulation shall meet or exceed 2015 IECC levels and achieve Grade 1 installation, per RESNET standards.

2009 International Energy Conservation Code (IECC)

Table 402.4.2 Air Barrier and Insulation Inspection Component Criteria, Walls: Corners, headers, narrow framing cavities, and rim joists are insulated. Table 402.4.2 Air barrier and thermal barrier: Exterior wall insulation is installed in substantial contact and continuous alignment with the air barrier. Air permeable insulation is not used as a sealing material.

2012, 2015, and 2018 IECC

Table R402.4.1.1 Air Barrier and Insulation Installation, Walls: Corners, headers, and rim joists making up the thermal envelope are insulated. Table R402.4.1.1, Air barrier and thermal barrier: A continuous air barrier is installed in the building envelope including rim joists and exposed edges of insulation. Breaks or joints in the air barrier are sealed. Air permeable insulation is not used as a sealing material.


Section R101.4.3 (Section R501.1.1 in 2015 and 2018 IECC). Additions, alterations, renovations, or repairs shall conform to the provisions of this code, without requiring the unaltered portions of the existing building to comply with this code. (See code for additional requirements and exceptions.)

2009 International Residential Code (IRC)

Table N1102.4.2 Air Barrier and Insulation Inspection Component Criteria, Walls: Corners, headers, narrow framing cavities, and rim joists are insulated. Table N1102.4.2 Air barrier and thermal barrier: Exterior wall insulation is installed in substantial contact and continuous alignment with the air barrier. Air permeable insulation is not used as a sealing material.

2012, 2015, and 2018 IRC

Table N1102.4.1.1 Air Barrier and Insulation Installation, Walls: Corners, headers, and rim joists making up the thermal envelope are insulated. Table N1102.4.1.1, Air barrier and thermal barrier: A continuous air barrier is installed in the building envelope including rim joists and exposed edges of insulation. Breaks or joints in the air barrier are sealed. Air permeable insulation is not used as a sealing material.


Section N1101.3 (Section N1107.1.1 in 2015 and 2018 IRC). Additions, alterations, renovations, or repairs shall conform to the provisions of this code, without requiring the unaltered portions of the existing building to comply with this code. (See code for additional requirements and exceptions.)

Appendix J regulates the repair, renovation, alteration, and reconstruction of existing buildings and is intended to encourage their continued safe use.
Overview:

The intent of this brief is to provide code-specific information about insulated headers to help ensure that the measure will be accepted as being in compliance with the code. Providing notes for code officials on how to plan reviews and conduct field inspections can help builders or remodelers with proposed designs and installations and provide jurisdictional officials with information for acceptance. Providing the same information to all interested parties (e.g., code officials, builders, designers, etc.) is expected to result in increased compliance and fewer innovations being questioned at the time of plan review and/or field inspection.

Every house uses load-bearing walls to stabilize the structure and support the weight of the home. In load-bearing exterior walls, structural headers are placed above the frames for windows and doors to carry the load from the building above and transfer it to posts on both sides of the window or door opening. Structural headers are a point of increased heat loss because they are made from solid or laminated framing timbers with no insulation. Since the 2009 versions of the International Energy Conservation Code (IECC) and International Residential Code (IRC) were issued, clarifying language was added specifying that header cavities should be insulated and that the insulation should be at least R-3 per inch. Even though each version of the IECC/IRC codes includes provisions that the building thermal envelope should be durably sealed to limit infiltration and the materials used should allow for differential expansion and contraction, the language in the 2009 version was somewhat vague and did not identify specific components of the building thermal envelope or provide explanations of how these components should be insulated and sealed. The 2012 IECC/IRC added more specific language regarding areas of the building thermal envelope that should be sealed and expanded upon those areas that are now included in the 2015 IECC/IRC. This brief provides an overview of the 2009 through 2015 IRC/IECC code requirements related to air sealing and insulating structural headers.

1“Building Thermal Envelope” is defined as the basement walls, exterior walls, floor, roof, and any other building elements that enclose conditioned space or provide a boundary between conditioned space and exempt or unconditioned space.

Plan Review:

Per the IECC/IRC, Section R103.3/R106.3 Examination of documents. The code official/building official must examine or cause to be examined construction documents for code compliance.

This section lists applicable code requirements and details helpful for plan review regarding the provisions to meet the requirement for insulated and sealed structural headers.

• Construction Documentation. Review the construction documents for details describing header insulation, installation and construction techniques.
  ○ 2015 IECC/IRC, Section R103.2/N1101.5 Information on construction documents. Construction documents should include information about the insulation material, its R-values, and air sealing details.

• Air Leakage and Insulation. Review the construction documents and that confirm the insulation material, R-value, and air sealing technique meet the applicable code requirements.
2015 IECC/IRC, R402.4/N1102.4. Air leakage. The building thermal envelope should be constructed to limit air leakage.

- R402.4.1/N1102.4.1 Building thermal envelope. The sealing methods between dissimilar materials should allow for differential expansion and contraction.

- R402.4.1.1/N1102.4.1.1 Installation. The components listed in the Air Barrier and Insulation Installation Table should be installed in accordance with the manufacturer’s instructions and the criteria listed as the applicable method of construction. Below is the General Requirement and one component from the table that is applicable to structural headers.

- R402.4.1.1/N1102.4.1.1 Air Barrier and Insulation Installation Table
  - Air Barrier General Requirements. A continuous air barrier should be installed in the building envelope. The exterior thermal envelope contains a continuous air barrier. Breaks or joints in the air barrier should be sealed.

  - Air Barrier Criteria:
    - Walls – The junction of the foundation and sill plate should be sealed. The junction of the top plate and top of exterior walls should be sealed.

  - Insulation Installation:
    - Walls – Cavities within corners and headers of frame walls should be insulated by completely filling the cavity with a material having a thermal resistance of R-3 per inch minimum. Exterior thermal envelope insulation for framed walls should be installed in substantial contact and continuous alignment with the air barrier.

2012 IECC/IRC, R402.4/N1102.4 Air leakage. The building thermal envelope should be constructed to limit air leakage.

- R402.4.1/N1102.4.1 Building thermal envelope. The sealing methods between dissimilar materials should allow for differential expansion and contraction.

- R402.4.1.1/N1102.4.1.1 Installation. The components listed in the Air Barrier and Insulation Installation Table should be installed in accordance with the manufacturer’s instructions and the criteria listed as the applicable method of construction. Below is the only component from the table that is applicable to structural headers.

- R402.4.1.1/N1102.4.1.1 Air Barrier and Insulation Installation Table
  - Walls – Corners and headers should be insulated and the junction of the foundation and sill plate should be sealed. The junction of the top plate and top of exterior walls should be sealed. Exterior thermal envelope insulation for framed walls should be installed in substantial contact and continuous alignment with the air barrier.

2009 IECC/IRC, 402.4.1 Air leakage, Building thermal Envelope

- The building thermal envelope should be constructed to limit air leakage. The sealing methods between dissimilar materials should allow for differential expansion and contraction. Sources of infiltration should be caulked, gasketed, weather stripped, or otherwise sealed with an air barrier material, suitable film, or solid material. This section does not specifically address areas applicable to structural headers.

Building additions that include a header construction also are subject to the header insulation requirements listed in the IECC/IRC. However, existing wall cavities exposed during construction provided that the cavities are filled with insulation, are exempt from having to meet the provisions of the code.

2“Continuous air barrier” is defined as a combination of materials and assemblies that restrict or prevent the passage of air through the building thermal envelope.

3“Air Barrier” is defined as material(s) assembled and joined together to provide a barrier to air leakage through the building thermal envelope. An air barrier may be a single material or a combination of materials.

4“Building Thermal Envelope” is defined as the basement walls, exterior walls, floor, roof, and any other building elements that enclose conditioned space or provide a boundary between conditioned space and exempt or unconditioned space.

Field Inspection:

Per the 2015 IECC, Section R104 Inspections. Construction or work for which a permit is required is subject to inspection. Construction or work is to remain accessible and exposed for inspection purposes until approved. Required inspections include footing and foundation, framing and rough-in work, plumbing rough-in, mechanical rough-in, and final inspection.
Per the 2015 IRC, Section R109 Inspections. The wording is somewhat different in that for onsite construction, from time to time the building official, upon notification from the permit holder or his agent, can make or cause to be made any necessary inspections. Further details are provided for inspections regarding foundation, plumbing, mechanical, gas and electrical, floodplain, frame and masonry, and final inspection. Any additional inspections are at the discretion of the building official.

This section provides details for inspecting to the specific provisions for insulated headers where one or more specific type of inspection per the IECC or IRC may be necessary to confirm compliance. Verifying code compliance for insulated headers would typically be at the framing and rough-in work inspection.

- Confirm that the insulation material meets ratings approved on the construction documents.
- Confirm that insulation has been installed properly so the insulation coverage is continuous and complete. The following websites provide information on insulated header installation:

Technical Validation(s):

This section provides additional information and helpful resources.

More Info.

Access to some references may require purchase from the publisher. While we continually update our database, links may have changed since posting. Please contact our webmaster if you find broken links.

Case Studies

1. **New Whole-House Solutions Case Study: Insight Homes: Deep Creek, Seaford, Delaware**
   - (867KB)
   - **Author(s):** PNNL
   - **Organization(s):** PNNL
   - **Publication Date:** April, 2012
     - Case study about a home builder that has refined its home designs to achieve HERS scores of 49 to 56 on 40 to 70 homes per year.

References and Resources*

1. **Advanced Framing Construction Guide**
   - **Author(s):** APA - The Engineered Wood Association
   - **Organization(s):** APA - The Engineered Wood Association
   - **Publication Date:** January, 2014
     - Detailed guide to advanced framing, a system of construction framing techniques designed to optimize material usage and increase energy efficiency.

2. **Advanced Wall Framing**
   - **Author(s):** NAHB, Southface Energy Institute, Oak Ridge National Laboratory, National Renewable Energy Laboratory
   - **Organization(s):** NAHB, Southface Energy Institute, Oak Ridge National Laboratory, National Renewable Energy Laboratory
   - **Publication Date:** January, 2002
     - Information sheet about advanced wall framing.

3. **Building Plans for Advanced Framing**
   - **Author(s):** Green Building Advisor
   - **Organization(s):** Green Building Advisor
   - **Publication Date:** December, 2013
     - Information sheets containing plans and details for advanced framing.

4. **Building Science Insights: Advanced Framing**
   - **Author(s):** Lstiburek
   - **Organization(s):** Building Science Corporation
   - **Publication Date:** February, 2010
     - Report detaining advanced framing techniques, including discussion of cost and energy savings.

5. **No Headers in Nonbearing Walls - Code Notes, Article 125**
   - **Author(s):** Department of Energy
   - **Organization(s):** DOE
   - **Publication Date:** March, 2011
     - Document providing supplemental information for code enforcement professionals about headers in nonbearing walls.

6. **Thermal Enclosure System Rater Checklist Guidebook**
   - **Author(s):** U.S. Environmental Protection Agency
   - **Organization(s):** EPA
   - **Publication Date:** October, 2011
     - Guide describing details that serve as a visual reference for each of the line items in the Thermal Enclosure System Rater Checklist.

*Publication dates are shown for formal documents. Dates are not shown for non-dated media. Access dates for referenced, non-dated media, such as web sites, are shown in the measure guide text.

Contributors to this Guide

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