

**INTERPRETATION IC 90.1-2001-12 OF
ANSI/ASHRAE/IESNA STANDARD 90.1-2001
Energy Standard for Buildings Except Low-Rise Residential Buildings**

January 25, 2004

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Reference: This request for interpretation refers to the requirements presented in ANSI/ASHRAE/IESNA Standard 90.1-2001, Section 5 Building Envelope, specifically Sections 5.1.4, 5.2.1, 5.3.1d, 5.3.1.4 and Figure 5.3 relating to floor insulation.

Background: Section 5.3.1.4 requires floor insulation per requirements specified in Table 5.3; further delineated in Tables B-1 through B-26. Floors over a ventilated crawl space under Table B-8 (North Central Texas-Dallas), as an example, (Residential) require a continuous insulation system with an R-Value of 6.3 for mass floors, R-19 for steel joist and wood framed floors. Architects are requesting assistance from engineers on how to meet the Standard. Structural engineers indicate that they can not provide for continuous insulation in or above a mass floor condition. Currently it is being suggested that insulation below the structure is the only way to meet the Standard. Most Steel joist systems (a very common structural system) have fluted steel pans laying on top of the joists. Batt insulation between joists allows airflow above the insulation through the flutes and joists. Crawl space conditions further have a high moisture content that severely reduces the effectiveness of this insulation system. Crawl spaces need to be ventilated to reduce the moisture level therein which does allow outside air into this cavity. However, there are many days and hours throughout the year where the cool ground temperature in this area is actually beneficial. The effectiveness of the required insulation system (wet and porous with significant air bypass), the added cost to install it and the potential counterproductive result have raised questions about the proper way to handle insulating these floor systems economically and effectively.

Interpretation 1: For mass floors the insulation shall be on the interior above the slab/structure or on all exposed surfaces below the floor including beams that extend 24 inches and less below the exposed floor. Structural Engineers tell us the insulation must be installed underneath the structure without exception. The Standard suggests otherwise. For steel joist floors the insulation value is for uncompressed insulation installed in the cavity between the steel joists or for sprayed on insulation. This can also be continuous insulation where uninterrupted by framing, either above the floor structure or below the framing cavity completely filled with insulation. We interpret that batt insulation, meeting the R-value listed, suspended between the joists complies. Please note that this type of insulation will be in a high humidity space, will have a questionable installation quality and will have air bypassing the insulation up through the joists and floor pan system.

Question 1: Is this interpretation correct?

Answer 1: Your interpretation is primarily correct, but you have mixed competing issues. Your analysis of the results of using batt insulation in a vented crawl space is also correct – that there will be moisture problems. For a complete answer, the following must be considered:

1. Section 3.2 includes the following definitions:
 - *mass floor*: a floor with a heat capacity that exceeds (1) 7 Btu/ft² °F or (2) 5 Btu/ft² °F provided that the floor has a material unit mass not greater than 120 lb/ft³.
 - *steel joist floor*: a floor that (1) is not a mass floor and (2) that has steel joist members supported by structural members.

In other words, if a floor meets the HC requirements above, it is considered a mass floor even if it is supported by steel joists – it is not considered a steel joist floor.

2. Section 5.3.1.4.a requires that for a mass floor “Where framing, including metal and wood joists, is used, compliance shall be based on the maximum assembly *U-factor* rather than the minimum *rated R-value of insulation*.” Therefore, if the floor is a mass floor, batt insulation meeting the R-value listed is not acceptable as a basis for compliance. You must use the slightly more complicated, but more accurate, method of calculating the overall U-factor for the assembly and compare that to the U-factor listed.
3. The second portion of your stated interpretation quotes directly from Section 5.3.1.4.b of the Standard for a steel joist floor and is correct that uncompressed batts between framing members complies for the first rated R-value (the only rated R-value currently in Tables B-1 through B-26). However, as stated above, for mass floors the requirements of Section 5.3.1.4.b do not apply.
4. Standard 90.1 does not give guidance for moisture control in conjunction with allowable insulation strategies. There are problems in the assumptions made and the batt insulation solution proposed. Although the project’s structural engineer may not allow interior insulation, the Standard does allow this as stated above, and there are several methods for providing insulation above the structure. Extruded polystyrene may be selected with a second wearing slab, cement board or self-leveling underlayment installed above the insulation layer. Extruded polystyrene can be purchased in various compressive strengths appropriate for most bearing conditions. Interior insulation likely to be the best solution because it will avoid the moisture and thermal bridging problems discussed below.

The choice of venting the crawl space and insulating with batt insulation almost ensures moisture problems. (Once again, if you select this option, compliance requires the use of the U-factor rather than using the minimum R-value.) In your climate, the crawl space will be vented with high moisture content air much of the year. That moisture reduces the effectiveness of batt insulation and the moisture may come in contact with a surface cooled below the dew point by air conditioning or climate conditions, causing condensation, mold growth and corrosion. A better strategy for that climate is to insulate the perimeter walls, provide an unvented crawl space and control ground moisture using a taped polyethylene ground cover. This effectively brings the crawl space inside the thermal envelope and keeps the moisture out of the envelope.

Assuming you still want to vent the crawl space and insulate the floor from the underside, a better solution would be a closed-cell spray foam insulation, such as spray polyurethane foam (SPF), instead of the glass-fiber batt solution proposed. The SPF would act as an air and vapor barrier as well and will reduce the potential of moist air coming in contact with

condensing surfaces (so long as thermal bridges are accounted for, by adding insulation at the joists).

Interpretation 2: This interpretation holds true for both 90.1-1999 and 90.1-2001.

Question 2: Is this interpretation correct?

Answer 2: Yes, with the comments above.