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Watch Out For Faulty Cathedral Ceiling Construction!

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If you've seen one cathedral or vaulted ceiling, you may not have seen them all. While many builders often use this type of ceiling in their residential construction because their consumers like the feeling of openness it gives, moisture-related problems can develop when certain rules are not followed, resulting in costly callbacks from the consumer. Figure 1 shows a home that has severe moisture problems due to poor cathedral or vaulted ceiling design and construction.

The first distinction that may separate one vaulted ceiling from another is whether it is vented or unvented. While unvented roof systems are warranted in certain circumstances, such as in geographical areas with fine snow and high winds, great care must be taken to ensure a durably airtight ceiling in addition to design and construction that locates possible dewpoint planes in a low permeable, insulative material.

Current building practices in cold climates primarily use vented cathedral ceilings. What follows will be a brief discussion of the basic elements and construction details for a sound vented cathedral or vaulted ceiling.

There are six basic elements in the vented cathedral ceiling that are critical to successful construction. they include the following:

* Structural members
* Exterior moisture barrier
* Ventilation
* Insulation
* Air barrier
* Vapor retarder

While all six elements are important, there is not room to discuss all of them here. Structural members and exterior moisture barriers will not be addressed in this article.

Ventilation

Ventilation of attics and ceilings is very effective in reducing summer heat gain through the ceiling. It also removes water vapor from the ceiling/roof system that may have diffused or leaked from the house. Ventilation can also aid in drying water that may have leaked into the cavity due to a failure of the exterior moisture barrier or condensed in the cavity during the winter. Another important benefit occurs during the winter when ventilation can help maintain a uniform roof deck temperature by removing escaping heat. This is critical in controlling ice dam development.

To ensure proper air movement, the ventilation space should have a depth of 2 to 3 inches. This air space, coupled with the necessary depth for insulation, can be obtained by using high-heeled scissors trusses, parallel chord trusses, wood I-beams, or furring-out 2x12s on the top or bottom. Screened openings to the vented space should provide 1 square foot (144 square inches) of free net area for every 300 square feet of ceiling area. Each rafter cavity should have ventilation. Half of the required vent opening should be near the ridge and half should be distributed at the eaves. Continuous ridge and soffit vents are preferred to periodic roof and soffit vent openings. Any vent system must be designed to resist the entry of snow and rain.

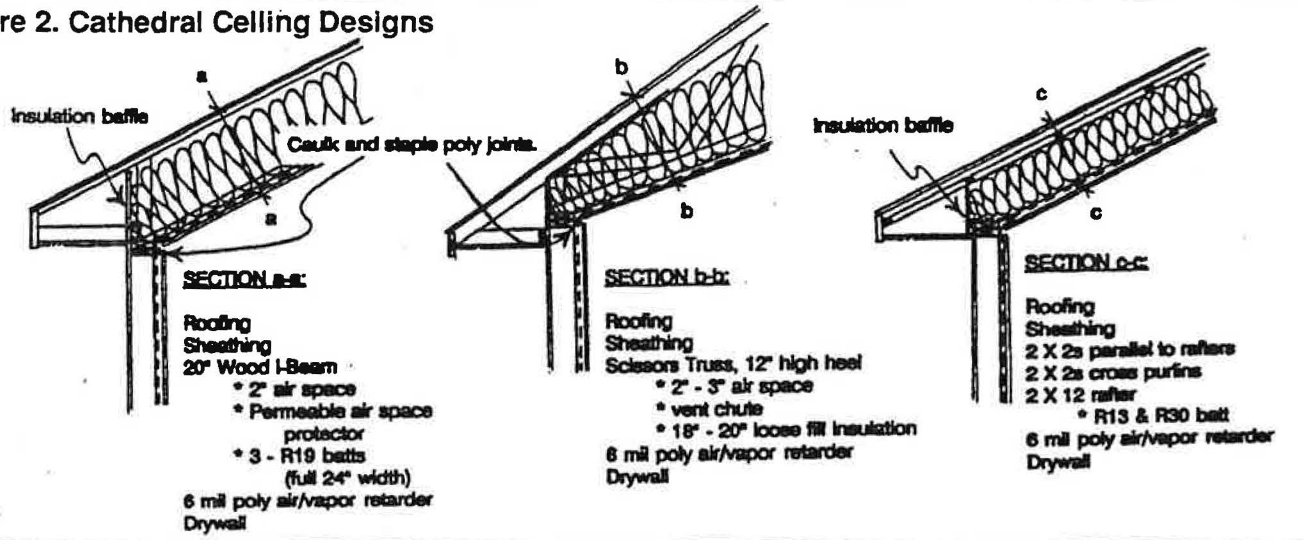
Insulation

Insulation levels in cathedral ceilings build here in Minnesota should range from R-40 to R-60. The R-value for this type of ceiling needs to be higher to reduce heat loss than that found in flat ceilings with attic spaces because of its reduced ventilation capacity. Insulation at the eaves must cover the double top plate of the wall and be protected from (yet not block) the ventilation air stream. Figure 2 illustrates the proper placement of insulation and blocks for a vented cathedral ceiling.

Air Barrier

The most critical element in the cathedral ceiling is the AIR BARRIER! Three factors create pressure differences between the inside and outside of a house: wind; mechanical systems; and the buoyancy of warm, moist air. When the pressure inside the house is greater than that of the outside; warm, moist air will flow out and more than likely reach the dew point and condense (during the winter) in the ceiling/roof system. When dealing with moisture problems due to an internal moisture source in northern climates, it has been shown that air leakage transports much more water than diffusion. Because of this, it is imperative that an air barrier exist in the ceiling and that it be 100% continuous. Polyethylene or drywall can function as the air barrier <u>but they must be installed in a continuous manner.</u> For example, if polyethylene is used as the air barrier it must have durable and effective seals at the seams, electrical outlets, exposed beams, across interior partitions, and at intersections with exterior walls.

Figure 2. Cathedral Celling Designs



Any penetration through the air barrier puts the performance of the cathedral or vaulted ceiling at risk. Skylights and recessed lights place the air barrier at risk and can significantly degrade the thermal performance of cathedral ceiling systems.

WARNING: It is imperative that exhausting or combustion devices have sufficient make-up air or combustion air in tightly constructed homes.

Vapor Retarder

All other things being equal, water molecules move from warm to cold regions or from areas of high concentration to areas of low concentration. Because of this type of water movement (which is called diffusion), vapor retarders are required on the warm sides of walls and ceilings to prevent moisture movement to potential sites of condensation. Most codes require a vapor retarder with a perm value below 1 on the warm side of a wall or ceiling.

Figure 2 illustrates three good cathedral ceiling configurations for cold climates. Each incorporates good ventilation, adequate insulation, a continuous air barrier, and a vapor barrier.

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Correction and Apologies

To all those people who tried to order material from the NAHB Research Foundation at the address listed in last issue's No.B.S. Unfortunately the Research Foundation has moved and the forwarding time has expired.

The correct address is:

NAHB National Research Center
400 Prince Georges Blvd.
Upper Marlboro, MD 20772-8731
Telephone: (301) 249-4000

The Energy Resource & Information Center in Anchorage has a video developed by the Oregon Energy Extension Service that covers the topic of optimum value engineering, called "Advanced Framing".

Call 800-478-4636 or, in Anchorage, 273-9457 to check it out.