

INSULATING STEEL STUD FRAMED WALLS

by Joseph T. Kohler, Ph.D., P.E.

Insulation of steel stud framing system presents several challenges to the designer and builder. A proper insulation system must meet several criteria:

1. Satisfy energy code requirements
2. Provide satisfactory thermal performance in real world conditions
3. Avoid moisture problems
4. Be economical to construct
5. minimize the use of materials that may pose adverse health effects

This paper will discuss how typical insulation systems for steel stud walls in commercial buildings meet and fail to meet these criteria, and suggest an alternative approach for construction by designers and builders.

What does the code require?

Many jurisdictions use an energy code that contains or is modeled after ASHRAE 90.1. The R-Value of low mass wall systems in commercial buildings depends on city location, but is typically about R-14 in northern New England. These values were based on life-cycle cost analysis.

What is a typical steel stud wall system and why doesn't it perform well?

A typical wall assembly in common use consists of 6" steel studs with R-19 fiberglass batts, with a polyethylene vapor barrier and sheetrock on the inside, and exterior sheetrock and siding or brick veneer on the outside. While this wall system appears to meet the code "on paper", it does not meet it in practice. The problem is that the steel studs conduct heat readily, short circuiting the insulation. The American Iron and Steel Institute (Thermal Design Guide for Exterior Walls, 1995) rates the performance of this wall system as only R-10. Some building scientists rate it at closer to R-4, which is only marginally better than an uninsulated wall.

How can we prevent "Short Circuiting"?

The solution to this has been to add an inch thick layer of rigid foam to the exterior side of the steel studs to provide a thermal break. The American Iron and Steel Institute rates such an assembly at around R-16.

What's wrong with this solution?

One problem with this approach is that it creates two vapor barriers - one at the foam and the other at the poly vapor barrier. Moisture that gets through the poly vapor barrier (which has a lot of penetrations due to fasteners and electrical wiring) may accumulate in the fiberglass and possibly condense.

Another problem is the use of fiberglass batt insulation. The batts release fiberglass particles which may present a health hazard to workers installing the fiberglass. In addition, fiberglass can get wet from moisture entering from either the exterior or the interior - it acts like a sponge and takes a long time to

dry and provides an ideal environment for the growth of mold. Mold in fiberglass insulated walls and ceiling cavities is a frequent cause of indoor air quality problems.

Is there an alternate approach?

Yes. An alternate approach, while it may at first glance appear to be a radical suggestion, is to increase the thickness of the rigid insulation and omit the fiberglass insulation altogether. A wall assembly consisting of brick veneer, a reflective air space, two inches of R-8 isocyanurate foil faced insulation, a drain plain/vapor barrier, exterior gyp board, steel studs (empty cavity), and interior gyp board would provide a calculated R-value of about R-22.

It would offer the following advantages:

1. Easily meet the typical ASHRAE based energy code
2. Provide an exterior "drain plane" and an excellent vapor barrier with minimal penetrations
3. Allow the stud cavity to be used as a chase for electrical and communications wiring
4. Allow a reduction in stud size to 4" if structural considerations permit
5. Possibly reduce costs, by eliminating the need for an infiltration barrier on the outside, fiberglass insulation, and an interior vapor barrier
6. Eliminate a potentially unhealthy material from the job site

Is this a really new idea?

No, not really. Masonry walls are almost always constructed with this insulation system. The problem is that stud walls have always been insulated by filling the stud cavity. But this does not work with steel studs, and a thermal break constructed with rigid insulation is necessary. Once this material is introduced, why not use more of it and completely eliminate the fiberglass. Eliminating the fiberglass should more than pay for the extra inch of insulation. Construction details would then be similar to the typical masonry wall.

Why not add the fiberglass anyway and make an even better wall?

Consider the following:

1. We need to save money on the fiberglass to pay for the extra foam (projects don't have unlimited funding)
2. Fiberglass is not a healthy material and creates a place for mold
3. Adding fiberglass makes the stud space less useful as an electrical chase
4. The wall system easily meets the energy code without the fiberglass (and adding the fiberglass would save very little additional energy).