

RETROFIT WALL INSULATION STUDY

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Retrofit wall insulation is primarily intended to reduce the thermal conductivity of walls so that less energy will be transmitted through them. It can also reduce energy losses due to infiltration and can reduce the discomfort of interior draftiness. However, the value of retrofit wall insulation as a conservation measure is dependent upon the quality of its installation. Settling, incomplete filling of cavities, empty cavities, etc., can greatly reduce the effectiveness of the insulation.

The Bonneville Power Administration (BPA) conducted a series of retrofit wall insulation tests to determine how various obstructions and discontinuities within a wall cavity might affect the complete filling of that cavity. The test structure, located at BPA's Ross Complex in Vancouver, Washington, was comprised of four walls, each 8-feet by 12-feet. The structure was built so that all four walls could be dropped to lay flat on the ground. Two of the exterior walls had beveled siding while the other two were shingled. The interior walls were clear plexiglass, instead of sheetrock, to enable viewing of the filling process. Two of the soffits were enclosed, while the other two had exposed rafters. The test structure contained a total of forty-eight cavities and was built using standard construction practices. The following features, or combinations thereof, were built into the test structure:

0. Empty cavity, as constructed.
1. Let-in corner bracing (1" x 2").
2. Fire blocking.
3. Wiring which horizontally crossed cavity.
4. Vent or flue thimble.
5. Outlet boxes.
6. Switch boxes.
7. Unusual framing at windows and doors:
 - a. Narrow cavities.
 - b. Abrupt changes in cavity cross section.
8. Fasteners which protrude into the cavity (nails).
9. Roughened interior wall cavity surface to simulate lath and plaster.
10. Partial cavity insulated with R-5 or R-7 batts.
11. External soffits which restrict exterior access to the top of the wall cavity.
12. Plumbing (water pipe and/or vent stack).

All tests were conducted by local weatherization contractors, except for one cellulose test that was conducted by a manufacturer of cellulose insulation. All filling processes and techniques were left to the discretion of the contractor, except for the use of the one or two-hole filling method which was specified by BPA. None of the contractor personnel doing the insulating were allowed to view the interior of the test structure before filling the wall cavities so that none of the features built into the wall cavities could have been compensated for. A total of eight tests were conducted: four with cellulose, two with fiberglass, and two with rockwool. Three of the tests used the one-hole filling method while the others used the two-hole filling method. Of the three contractors who used the one-hole filling method, only one used a filler tube.

After all the wall cavities had been insulated, all void spaces, or empty cavities were noted. The soffits were lifted off the walls, and the walls of the test structure were dropped. The plexiglass was carefully removed so as to not disturb the insulation. All the cavities were divided into sections. Although most of the cavities were divided into three sections, upper, middle, and lower, some did vary depending upon size, or configuration. The insulation from each of the sections was removed and weighed, and the density was then calculated. The densities were used to determine whether or not the various cavity sections had a proper insulation level so as to provide the proper R value.

The data is currently being organized and has not yet been analyzed. The results discussed are very preliminary and are mainly from the visual observation of the filling of the wall cavities, and a quick overview of the data. The following trends were observed:

- Virtually all cavity densities were above the maximum recommended density. This was especially true for those cavities that were left empty, as constructed.
- Fire blocking had no effect upon the cavity densities. There were one or two cases where the installer didn't realize the fireblocking was there, and the portion of the cavity under the fireblocking remained empty.
- Those cavity sections with wiring generally had voids directly under the wiring when blowing wools were used. In the case of cellulose, the wiring didn't result in voids, but the densities below the wiring were much lower than the rest of the cavity. If any settling of the cellulose occurred, voids would have resulted. Use of a filler tube totally avoided this problem since the insulation was initially introduced below the wiring.

- The densities of the cavities containing simulated lath and plaster or the R-5 batts were scattered from below to above the recommended density for all types of insulation.
- The narrow cavities had no effect upon the insulation density. There were a couple of instances where the combination of a switchbox and horizontal wiring resulted in a blockage of the insulation leaving the lower half of the cavity empty.
- The vent or flue thimble had no effect upon insulation density either. It merely resulted in the drilling of more holes in order to fill the small cavities. There were instances where the small cavities around the vent were missed, and they remained empty.
- The soffits had no affect upon reaching upper cavities. It only made it more time consuming and difficult to drill the holes to fill those cavities.
- Corner bracing, plumbing, switchboxes, outletboxes, and fastners protruding into the cavity seemed to have no effect upon cavity density. Densities were within or exceeded the recommended density range which was typical of most cases.

Voids in the top corners of the cavities were found to be fairly common. It was noticed that if the installer would turn the nozzle upward, before pulling it out of the hole, those voids would be filled. The above observations were generally true, regardless of type of insulation or filling method used. The most obvious observation was that the quality of the installation job was very dependent upon the contractors experience.