

3. Windows – Frames, coatings, orientation and overhangs

Survey results of windows

Today's builders are all selecting double-pane windows. In most cases the survey found that the selection of solid aluminum-frame windows, which have no thermal break, was the reason that homes failed to meet the Energy Code (See **Appendix B**). Vinyl-frame windows are becoming cost-effective and provide a greater level of comfort because the frames are close to the inside temperature. Solid aluminum frames transfer the outside temperature inside.

There are several important considerations in the design and product selection of windows:

- **Window area** – A larger window area decreases the wall area and reduces the overall efficiency of the wall. About one-quarter of homes in the survey had window areas equal to or greater than 15 percent of the gross wall area.
- **Window frame type** – Thermal-break and vinyl windows are better at reducing heat transfer. Their frames also reduce window condensation and sweating. They feel more comfortable because of their higher radiant temperature.
- **Glass** – Special coating films (low-e and "summer low-e"), inert gas fillings, and the width of the gap between the panes all contribute to a window's efficiency. See **Appendix D** for descriptions of window technologies.
- **Window orientation** – Attention to orientation, combined with a good overhang, can reduce summer overheating and lower winter heating costs. See **page 27**.
- **Overhangs** – Properly sized overhangs reduce summer sunshine through south-facing windows. **Pages 28 and 29** give instruction on sizing overhangs in Arkansas.



This house shows an example of poor window orientation and a good overhang.

- The front of the home faces west, and there are several windows on the second floor that allow the summer sun to overheat the top floor. The selection of "summer low-e" windows would have reduced the overheating.
- The overhang above the entry shades the bottom floor's windows from the harsh summer sun.

Suggested window options for Arkansas

- To compensate for a large window area, use higher efficiency windows. Look for the National Forestration Rating Council label and try to get a U-Value of 0.56 or lower. If no NFRC label is present, use the default U-Values in Appendix D. Higher efficiency, more expensive windows have inert gas fillings; however, the extra expense for these might not be justifiable in our mild winter climate.
- Select vinyl-frame windows. Thermal-break, aluminum windows are better than solid aluminum frames, but vinyl-frame windows are now cost competitive and are much better at reducing heat loss.
- If possible, design the window areas based on orientation. Reduce the east-facing and especially the west-facing window areas as much as possible to cut down on summer overheating. Maximize the south-facing window area to reduce winter heating costs and build an overhang above these windows to reduce summertime overheating.
- Unobstructed east-facing and especially west-facing windows allow the sun to overheat a home. Windows that reduce the solar heat gain (summer low-e or "spectrally selective") reduce the air conditioning load. Look for the NFRC label and check that the Solar Heat Gain Coefficient (SHGC) is 0.55 or less.
- Use regular (winter) low-e on north- and south-facing windows for increased levels of wintertime performance.
- Skylights add both heating and cooling costs. Their construction typically increases the area of the ceiling with hard-to-insulate vertical areas, and they provide opportunities for air and water leakage.

Designing window areas to reduce energy use

The survey found that the average window area was about 15 percent of the gross wall area or 12 percent of the floor area. Many homes failed Code due to a larger than average window area (see **Appendix B**). When designing a building, do a quick calculation of the percentage of window in the gross wall. If this number is 15 percent or greater, and no reduction in window area is possible, then either extra insulation or higher quality windows will be needed to reduce the impact of the excessive window area. A small window area does not guarantee an overall good energy performance, but it makes it easier.

To calculate the percentage of window area in the wall:

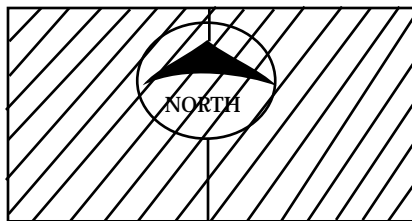
- 1) Gross wall area = perimeter length x wall height
- 2) Percent window = total window area ÷ gross wall area

For example, if the perimeter length is 180 feet and the wall height is 9 feet, the gross wall area is $180 \times 9 = 1620$ square feet.

If the total window area is 240 square feet, the percent of window in the gross wall is $240 \div 1620 = 0.148$ or 15 percent.

North: Smaller window area reduces winter heat loss.

West: Fewer windows lower cooling needs.



East: Smaller window area lowers cooling needs.

South: Larger window area improves winter heat gain. Overhangs reduce summer sun.

Window orientation is critical to comfort and operating cost.

Overhangs on south-facing windows

In the winter, south-facing windows reduce heating costs. If these windows have even a small overhang to reduce summertime overheating, they can admit the low-angled winter sun to reduce heating costs and then shade the high-angled summer sun to reduce the load on the air conditioner. The shading of the sun is based not only on the overhang length (see graphic on right) but the distance of the overhang to the bottom of the window (height).

The graphic to the right gives the information needed to design an overhang that will reduce the summertime sunlight and allow the entry of the beneficial wintertime sun. There is an easy-to-follow rule for overhangs: **Length = Height ÷ F** where "F" is a factor based on our north latitude. There are two options presented here: the first provides full shade in the middle of summer (**F-mid summer is June 21**), and the second provides full shade for the full summer (**F-full summer is from May 5 to August 1**).

Here's an example of how this works. If a home is being built in Fayetteville and it was desirable to shade the window the entire summer season, use the "F-full summer" for the north Arkansas region, which is 3.0. If the height from the bottom of the window to the bottom of the overhang is 72 inches, the length of the overhang is $\text{Length} = 72 \div 3.0 = 24$ inches.

Latitude	Arkansas Region	Cities	F-mid Summer	F-full Summer
33°	South	Texarkana El Dorado	5.85	3.75
34°	Central	Little Rock Pine Bluff	5.40	3.50
35°	North Central	Ft. Smith Conway	4.95	3.25
36°	North	Fayetteville Jonesboro	4.50	3.00

Length = Height / "F"

Source: Edward Mazria, *The Solar Home Book*

