Types of Windows

Windows come in a number of different frame and glazing types. By combining an energy-efficient frame choice with a glazing type tailored to your climate and application, you can optimize performance of windows in a building.

Improving the thermal resistance of the frame can contribute to a window's overall energy efficiency, particularly the U-factor. There are advantages and disadvantages to all types of frame materials, but vinyl, wood, fiberglass, and some composite frame materials provide greater thermal resistance than metal.

- Aluminum or metal frames. Although very strong, light, and almost maintenance free, metal or aluminum window frames conduct heat very well, which makes metal a very poor insulating material. To reduce heat flow and the U-factor, metal frames should have a thermal break -- an insulating plastic strip placed between the inside and outside of the frame and sash.
- Composite frames. Composite window frames consist of composite wood products, such as particleboard and laminated strand lumber. These composites are very stable, they have the same or better structural and thermal properties as conventional wood, and they have better moisture and decay resistance.
- Fiberglass frames. Fiberglass window frames are dimensionally stable and have air cavities that can be filled with insulation, giving them superior thermal performance compared to wood or uninsulated vinyl.
- Vinyl frames. Vinyl window frames are usually made of polyvinyl chloride (PVC) with ultraviolet light (UV) stabilizers to keep sunlight from breaking down the material. Vinyl window frames do not require painting and have good moisture resistance. The hollow cavities of vinyl frames can be filled with insulation, which makes them thermally superior to standard vinyl and wood frames.
- Wood frames. Wood window frames insulate relatively well, but they also expand and contract in response to weather conditions. Wood frames also require regular maintenance, although aluminum or vinyl cladding reduces maintenance requirements.

In addition to choosing a frame type, you will need to consider what type of glazing or glass you should use to improve the building's energy efficiency. Based on factors including window orientation, climate, building design, etc., you may need to choose different types of glazing for different windows throughout a building.

- Gas fills. To improve the thermal performance of windows with insulated glazing, some manufacturers fill the space between the panes with inert gas -- commonly argon or krypton -- that has a higher resistance to heat flow than air.
- Heat-absorbing tints. Heat-absorbing window glazing contains special tints that change the color of the glass. Tinted glass absorbs a large fraction of the incoming solar radiation through a window, reducing the SHGC, VT, and glare. Some heat, however, continues to pass through tinted windows by conduction and re-radiation, so the tint doesn't lower a window's U-factor. Inner layers of clear glass or spectrally selective coatings can be applied on insulated glazing to help reduce these types of heat transfer.

The most common gray- and bronze-tinted windows are not spectrally selective, and reduce the penetration of both light and heat. Blue- and green-tinted windows offer greater penetration of visible light and slightly reduced heat transfer compared with other colors of tinted glass. In hot climates, black-tinted glass should be avoided because it absorbs more light than heat. Tinted, heat-absorbing glass reflects only a small percentage of light, so it does not have the mirror-like appearance of reflective glass. Note that when windows transmit less than 70% of visible light, indoor plants can die or grow more slowly.

- Insulation. Insulated window glazing refers to windows with two or more panes of glass. To insulate the window, the glass panes are spaced apart and sealed, leaving an insulating air space. Insulated window glazing primarily lowers the U-factor, but it also lowers the SHGC.
- Low-emissivity (low-e) coating is a microscopically thin, virtually invisible, metal or metallic oxide layer deposited directly on the surface of one or more of the panes of glass. These low-e coatings control heat transfer by reducing the transmittance of infrared radiation. They are primarily used as a coating on the interior surface of windows in the cold climate. Although low-e coatings are usually applied during manufacturing, some are available for do-it-yourselfers. If applied correctly, these films are inexpensive compared to total window replacements, save energy in cold climates, reduce fabric fading, and increase comfort.
- Reflective coatings on window glazing or glass reduce the transmission of solar radiation, blocking more light than heat. Therefore, they greatly reduce a window's VT and glare, but they also reduce a window's SHGC. Reflective coatings usually consist of thin, metallic layers, and come in a variety of colors, including silver, gold, and bronze. Reflective window glazing is commonly used in hot climates to control solar heat gain. The reduced cooling energy demands can be offset by the need for additional electrical lighting, so reflective glass is used mostly for special applications.
- A special type of low-e coating is spectrally selective, filtering out 40% to 70% of the heat normally transmitted through insulated window glass or glazing while allowing the full amount of light transmission. Spectrally selective coatings are optically designed to reflect particular wavelengths, but remain transparent to others. Such coatings are commonly used to reflect the infrared (heat) portion of the solar spectrum while admitting more visible light. They help create a window with a low U-factor and SHGC but a high VT. Spectrally selective coatings can be applied on various types of tinted glass to produce "customized" glazing systems capable of either increasing or decreasing solar gains according to the aesthetic and climatic effects desired. Computer simulations have shown that advanced window glazing with spectrally selective coatings can reduce the electric space cooling requirements of new buildings in hot climates by more than 40%.