Energy Codes – Their Impact on Metal Buildings Has Arrived

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This is not another article on cool roofs… so keep your cool! Cool roofs are just one aspect of the energy codes which have received much attention. However, metal buildings are affected by much more than the properties of a roof coating to reflect and emit radiation. This article will enlighten you on several recent developments in energy codes and their enforcement. It won't take a genius to understand the dramatic impact that this will have on metal buildings, although it was Einstein who first looked at energy conservation in metal buildings. His famous theory, $E=MC^2$, actually means "energy savings equals metal construction squared."

Building owners have always been concerned with the energy costs associated with maintaining their properties and providing for their occupants' comfort. But the importance and awareness of energy conservation has always been closely tied to geo-political events that produce large spikes in energy costs. The groundwork for making energy conservation a regulatory issue with more clout was initiated with the National Energy Policy Act (EPAct) of 1992. The Department of Energy (DOE) required each state to certify that it had reviewed and updated the provisions of its commercial building code regarding energy efficiency. The states had two years to demonstrate that their commercial building energy code met or exceeded the requirements of the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) 90.1-1989, *Energy Standard for Buildings Except Low-Rise Residential Buildings*.

It was relatively easy for states to show that they had a commercial building code on the books that would meet this requirement. Incentive and rebate programs offered by utilities were actually more effective in stimulating energy conservation than the energy codes because it took a decade for the codes to start to be enforced on a local level. Energy conservation through the enforcement of codes for commercial buildings is still not uniform across the country. The states that have adopted energy codes either have their own (e.g. California, Florida) or have adopted a model energy code. Most states are gravitating towards the International Energy Conservation Code (IECC), which is invoked by the International Building Code (IBC). ASHRAE 90.1 can be adopted directly as an energy code, but complying with ASHRAE 90.1 is also one alternative given by the IECC. An excellent source to see what energy code has been adopted by a particular state (as well as other energy code resources) is the DOE sponsored web site, http://energycode.pnl.gov.

The most important aspect of all energy codes, for a metal building or a metal roof, is the envelope requirement. The envelope is the outer shell of the building that is exposed to the weather and is comprised of the roof, walls, windows, skylights, and doors. There are three ways that the building envelope is evaluated to show compliance; 1) prescriptive approach, 2) trade-off approach, or 3) whole building approach. The first two approaches deal solely with the envelope components, while the whole building approach looks at the total energy usage of the building, including lighting, HVAC, etc. It is important to keep in mind that these requirements are only for buildings that are heated and/or cooled.

The prescriptive approach is the easiest to use and is the standard of comparison for the other two approaches. But it can be too restrictive for a metal building and therefore not cost effective. The properties that are prescribed depend on whether the envelope component is opaque or glazed. Opaque components, such as the roof and walls, are rated for their thermal efficiency by a U-value, or its reciprocal - an R-value. Depending on the geographic location of the building (usually referred to as a climate zone), the energy code prescribes a minimum R-value (or a maximum U-value) for the roof and wall depending on the type of construction. The type of construction is a parameter because an economic analysis is done to determine if additional insulation would pay for itself in energy savings in a prescribed payback period. Glazed components are rated by their U-value as well as a solar heat gain coefficient (SHGC).

The most common way to insulate a metal building roof or wall is to sandwich fiberglass batts between the metal roof and the metal purlins or girts. However, the compression of the insulation over the purlins or girts has a substantial impact on the thermal efficiency of this system. This is why one has to either test a representative sample or perform an advanced computer analysis to determine the actual U-value of the system. In this case, it is not just the reciprocal of the R-value of insulation used. The North American Insulation Manufacturers Association (NAIMA) has computed U-values for these systems that are commonly used. For example, a single layer of R19 insulation gives a U-value of 0.065 for a typical standing seam roof and a U-value of 0.098 for a through-fastened roof. This translates to an effective R-value of R15 and R10, respectively. The standing seam roof system is more efficient than through-fastened roofs because of the thermal blocks that are used at the purlins to reduce the heat transfer through the compressed insulation. Through-fastened roofs can’t utilize a typical thermal block because it can affect the diaphragm capacity and the purlin strength. MBMA has been looking at new materials for thermal blocks to try to overcome this problem.

The prescriptive requirement for the U-value of a metal roof varies for the codes mentioned above. For example, in California’s Title 24 Energy Code, the prescriptive U-value for a roof is 0.051 for most of the state, and 0.076 for the southern coastal areas. ASHRAE 90.1-2004 requires a metal building roof prescriptive U-value of 0.065 for all climate zones, except zone 8 (parts of Alaska), where the U-value required is 0.049. Therefore, it can be seen that a single layer of R19 (which is generally the standard way of insulating most metal buildings) would not meet the prescriptive requirements for any through-fastened roof, and would not meet the more stringent requirements of most of California for any metal roof system. Does this mean you can’t use a roof system that does not meet the prescriptive requirement? Not necessarily. You can try to comply with one of the other two approaches; but, it would require that you put more insulation in the walls, or use more energy efficient windows, or use less energy for the lights and HVAC systems.

This is just a brief introduction into what is required for a metal building or roof to comply with the energy codes. MBMA has been active in evaluating the codes – are they fair to metal buildings and metal roofs? Some of this effort is underway in conjunction with the Cool Metal Roofing Coalition. MBMA is also actively educating builders with respect to the emerging energy codes and what it will take to comply. This includes developing tools that can be used for the analysis of a building envelope. We don't want any surprises out there, as more stringent requirements become effective in some states -- and start to become enforced in others.

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