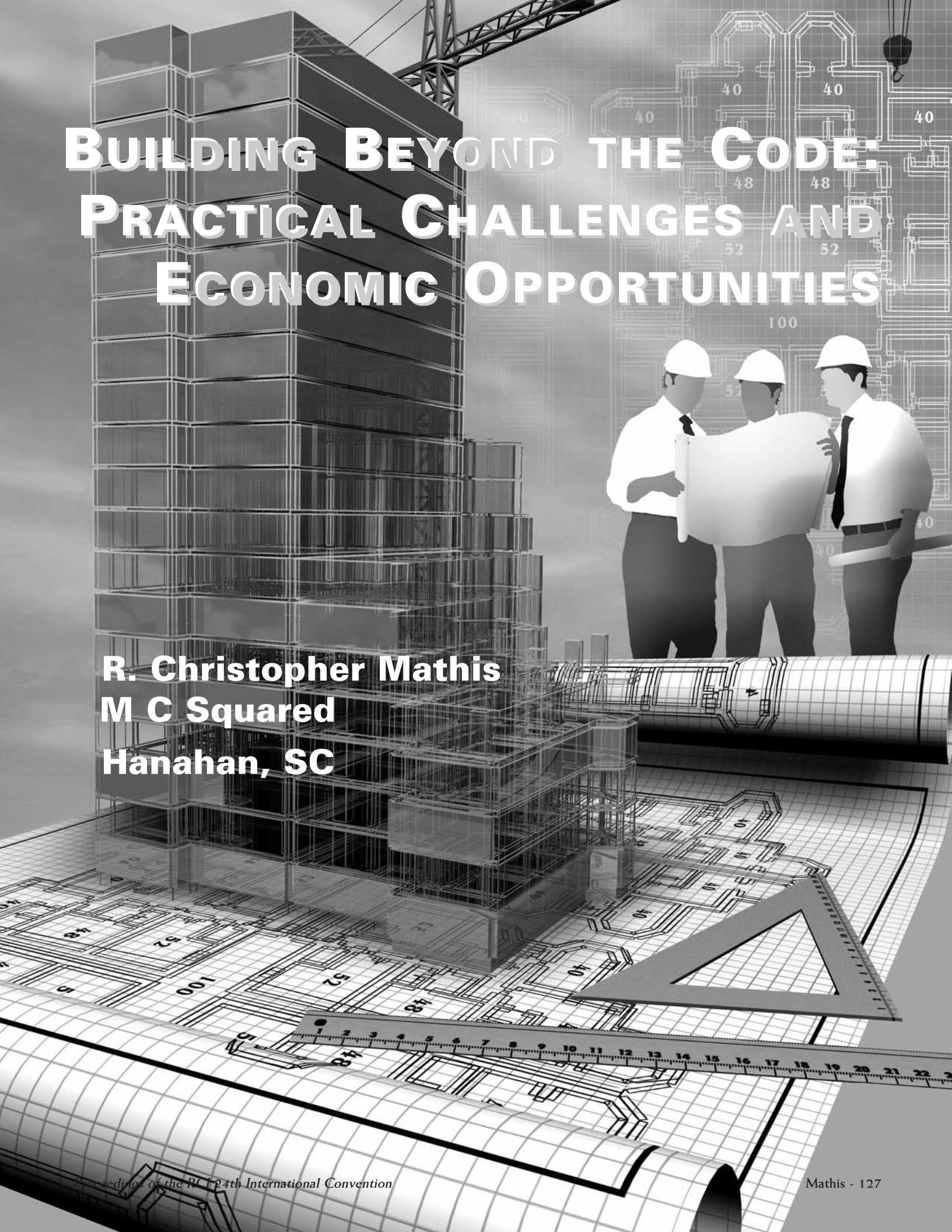
Building Beyond the Code: Practical Challenges and Economic Opportunities



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ABSTRACT

ASHRAE recently increased the minimum required roof insulation levels in Standard 90.1 – the national energy code for commercial buildings – to R-20, a 33% increase. ASHRAE's new requirement represents an emerging trend to make all buildings significantly more efficient and building professionals are looking for beyond-code recognitions (LEED, Energy Star, etc.) to deliver advanced building envelopes.

This presentation:

- Evaluates the economic assumptions about energy and building envelope costs used to develop the ASHRAE standard and compares those assumptions to the energy-cost reality of today
- Addresses the economic advantages of "beyond-the-code" programs, specifically investigating whether current minimum envelope R-values requirements should be raised even higher.
- Uses the analysis to evaluate the large-scale impacts of these decisions on existing and new buildings.

SPEAKER

Chris Mathis has spent the past 25 years studying how buildings and building products perform – from energy efficiency to code compliance to long-term durability. He has experience relevant to understanding the building codes and their implications. Mathis is president of MC Squared, Asheville, NC.

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Building Beyond the Code: Practical Challenges and Economic Opportunities

INTRODUCTION

The marketing of green building programs has reached new heights. "Sustainability" has become more than the new buzzword of the architectural community. Whether public sector programs or private, all have one thing in common – the recognition and requirement of building "beyond the code" as it relates to minimum levels of energy efficiency.

There is renewed marketplace emphasis in energy-efficient buildings. This interest has had dramatic impact on residential and commercial code development in ASHRAE as well as in private state codes like California Title 24 and the Florida Energy Code. For the first time in decades, we are seeing new requirements for improved building envelope performance, improved HVAC performance, and general resource conservation for all building types.

As the market seeks to address the challenges of natural resource conservation, peak power production, and air pollution by looking at the role of buildings in the overall energy consumption picture, the demand for buildings to perform at higher levels of efficiency is a necessity. From LEED to Energy Star to any of the number of would-be green building programs currently being promoted, each requires levels of energy efficiency beyond those minimums required by the code. Some programs require 15% more efficiency than the code. Others require 30% or more. The American Institute of Architects (AIA) has cited 50% more efficient than code or "carbon neutral" as reasonable and responsible goals.

But how do we go "beyond the code?" How do we determine where we should focus our efforts? And do we actually achieve the performance targeted? This paper addresses the front line in improved, delivered building efficiency – the building envelope. It compares the current roof and wall insulation values in ASHRAE 90.1 with those proposed in ASHRAE's green building standard – Standard 189. It identifies some of the challenges faced by building professionals in seeking to achieve energy efficiency "beyond the code."

ASHRAE 90.1-2007

Building envelope improvements to ASHRAE Standard 90.1 have been previously reported [Mathis, RCI 2007]. These improvements in minimum building energy efficiency were the start of a renewed interest in addressing the role of buildings in our overall national energy consumption, peak power, and air pollution picture. *Figure 1* shows a breakdown of total U.S. energy consumption by sector and *Figure 2* shows U.S. electricity consumption by sector. Recognizing that buildings play a key role in utility peak-load profiles, reducing building electrical demand – especially peak demand – becomes an increasingly important objective.

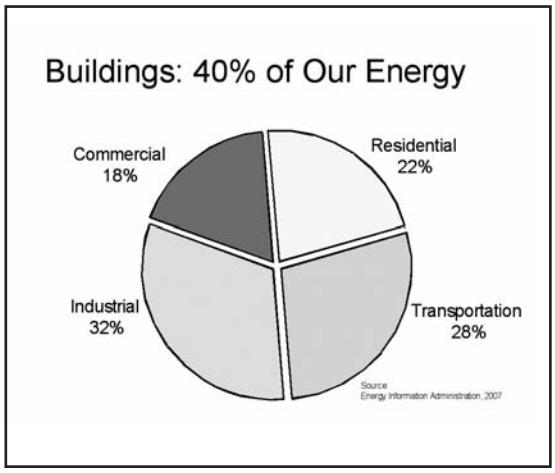

Figure 1 – Energy use by economic sector.

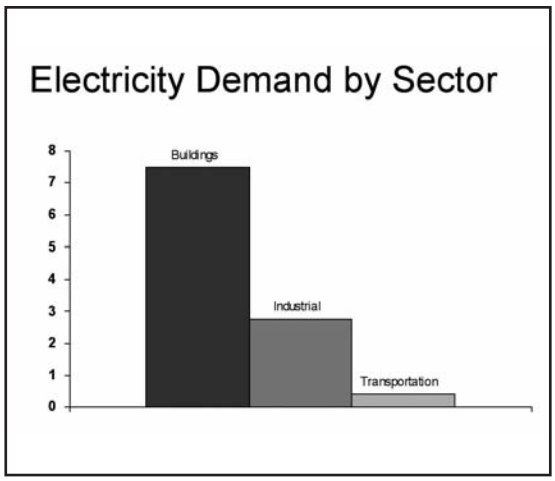

Figure 2 – Electricity demand by sector.

Concerns over global climate change and air pollution magnify the importance of focusing on reducing building electrical loads. *Figure 3* shows a breakdown of U.S. electrical production by fuel type.

While there were numerous changes made to ASHRAE 90.1-2007, this paper focuses on new minimum requirements to the opaque elements of the building

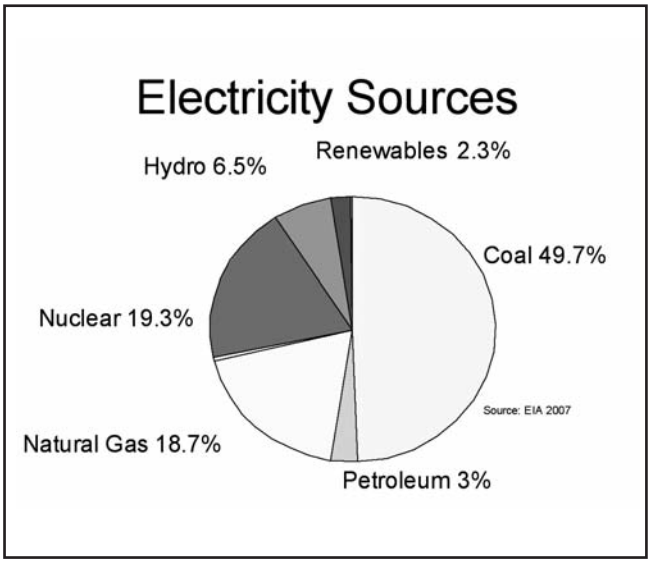

Figure 3 – Electricity production by fuel type.

envelope, where no significant changes had been made since 1989. With the exception of the "Metal Building" category – where consensus has yet to be reached – the 2007 version of the Standard now includes new minimums for roof and wall insulation levels. [Mathis, RCI 2007].

ASHRAE 189-P

At the same time as these new code minimums were being established, ASHRAE also began work on a new standard intended to address the growing marketplace demand for "green buildings." Working in partnership with the U.S. Green Building Council, the Illuminating Engineering Society of North America, and others, ASHRAE began working on Standard 189, entitled, "Standard for the Design of High-Performance Green Buildings Except Low-Rise Residential Buildings." This draft standard echoed many of the other green building programs emerging in the marketplace, requiring higher levels of building energy efficiency than embodied in the minimum code of 90.1.

Just like LEED, Energy Star, and other green marketing programs for buildings, ASHRAE Standard 189 sought to establish new "minimums" that delivered superior energy efficiency as a starting point for any building for which sustainability was a design objective. The question of "how much better" (i.e., 30%, 40%, 50% more efficient, etc.), while philosophically interesting, gave way to practical considerations of available technologies, better use of existing materials and systems, current state-of-the-art in broad marketplace acceptance, and achievability.

Integral to all of these objectives is the recognition that all energy efficiency starts with the building envelope. This is magnified by the recognition that the building lifespan may be 50, 75, 100 years or more, making a durable and efficient building envelope even more important.

Figure 4 shows the climate zones as defined for use with ASHRAE 90.1 and 189-P. It is the same climate zone map referenced in the International Energy Conservation Code (IECC).

Tables 1 through *8* show the evolution of roof and wall insulation levels by climate zone from 90.1-2004, to 90.1-2007 and to the values proposed in Standard 189 for commercial buildings. *Tables 9* through *16* show this same evolution for residential buildings (except for low-rise one and two-family buildings). *Tables 17* through *24* show this same evolution of opaque roof and wall insulation levels for semi-heated spaces. Following each set of building type-specific tables are general observations about the trends seen in the evolution of minimum insulation levels.

Tables 1-24 correspond to the climate zones shown on the map in *Figure 4* with the following marking conventions. (Note: These tables are abbreviated versions of the entire ASHRAE stan-

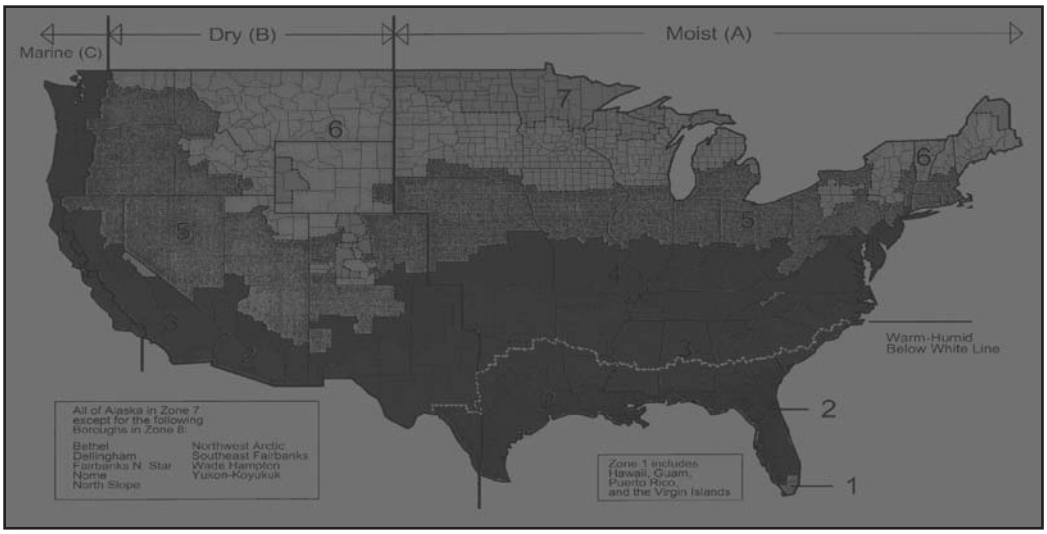

Figure 4 – Climate zones as defined for use with ASHRAE 90.1, 189-P, and the IECC.

dard tables, showing only the proposed insulation R-value changes for roofs and above-grade walls for three building types.)

- Where there are no specific roof, attic or wall insulation requirements in the Standard the table below shows "NR" for "No Requirement."
- R-values listed in the tables are minimum required R-values.
- "ci" means "continuous insulation required," such as with insulating sheathing. Other insulation values can mean cavity fills, etc.

GENERAL OBSERVATIONS REGARDING MINIMUM INSULATION REQUIREMENTS FOR COMMERCIAL BUILDINGS

The trends shown in proposed minimum insulation levels for commercial buildings can be characterized as follows:

1. As we seek greater levels of building energy performance, we will require building envelopes to significantly improve from their current practice and current minimum code requirements. Minimum R-values for roofs and walls will need to dramatically improve.
2. The general trend is for ever greater levels of continuous insulation ("ci") in both heating and cooling climates. While the standards are silent as to specific construction techniques and materials, the values shown reflect various construction techniques evaluated against ASHRAE cost effectiveness criteria and professional judgment. Where "R-13 + R-7.5 ci" is shown, it reflects R-13 batt insulation in between stud cavities, plus R-7.5 of

	Non-residential Buildings		
Opaque Elements	**90.1-2004**	**90.1-2007**	**189-P**
Roofs			
Insulation Entirely Above Deck	R-15ci	R-15ci	R-20ci
Metal Buildings	R-19	R-19	R-13 + R-19
Attic and Other	R-30	R-30	R-38
Walls, Above Grade			
Mass	NR	NR	R-5.7ci
Metal Building	R-13	R-13	R-13 + R-5ci
Steel Framed	R-13	R-13	R-13 + R-5ci
Wood Framed and Other	R-13	R-13	R-13 + R-3.8ci

Table 1. – Commercial opaque envelope requirements for Climate Zone 1 (essentially Miami and the islands).

	Non-residential Buildings		
Opaque Elements	**90.1-2004**	**90.1-2007**	**189-P**
Roofs			
Insulation Entirely Above Deck	R-15ci	R-20ci	R-25ci
Metal Buildings	R-19	R-19	R-19 + R-10
Attic and Other	R-30	R-38	R-49
Walls, Above Grade			
Mass	NR	R-5.7ci	R-7.6ci
Metal Building	R-13	R-13	R-13 + R-5ci
Steel Framed	R-13	R-13	R-13 + R-5ci
Wood Framed and Other	R-13	R-13	R-13 + R-3.8ci

Table 2 – Commercial opaque envelope requirements for Climate Zone 2 (primarily the Gulf Coast).

	Non-residential		
Opaque Elements	**90.1-2004**	**90.1-2007**	**189-P**
Roofs			
Insulation Entirely Above Deck	R-15ci	R-20ci	R-25ci
Metal Buildings	R-19	R-19	R-19 + R-10
Attic and Other	R-30	R-38	R-49
Walls, Above Grade			
Mass	R-5.7ci	R-7.6ci	R-9.5ci
Metal Building	R-13	R-13	R-13 + R-5ci
Steel Framed	R-13	R-13 + R-3.8ci	R-13 + R-5ci
Wood Framed and Other	R-13	R-13	R-13 + R-3.8ci

Table 3 – Commercial opaque envelope requirements for Climate Zone 3 (Southeast, most of CA).

	Non-residential		
Opaque Elements	**90.1-2004**	**90.1-2007**	**189-P**
Roofs			
Insulation Entirely Above Deck	R-15ci	R-20ci	R-25ci
Metal Buildings	R-19	R-19	R-19 + R-10
Attic and Other	R-30	R-38	R-49
Walls, Above Grade			
Mass	R-5.7ci	R-9.5ci	R-11.4ci
Metal Building	R-13	R-13 + R-13	R-13 + R-10ci
Steel Framed	R-13	R-13 + R-7.5ci	R-13 + R-10ci
Wood Framed and Other	R-13	R-13	R-13 + R-3.8ci

Table 4 – Commercial opaque envelope requirements for Climate Zone 4 (Virginia, St. Louis, etc.).

	Non-residential Buildings		
Opaque Elements	**90.1-2004**	**90.1-2007**	**189-P**
Roofs			
Insulation Entirely Above Deck	R-15ci	R-20ci	R-25ci
Metal Buildings	R-19	R-13 + R-13	R-19 + R-10
Attic and Other	R-30	R-38	R-49
Walls, Above Grade			
Mass	R-7.6ci	R-11.4ci	R-13.3ci
Metal Building	R-13	R-13 + R-13	R-13 + R-10ci
Steel Framed	R-13 + R-3.8ci	R-13 + R-7.5ci	R-13 + R-10ci
Wood Framed and Other	R-13	R-13 + R-3.8ci	R-13 + R-7.5ci

Table 5 – Commercial opaque envelope requirements for Climate Zone 5 (up to Chicago).

	Non-residential Buildings		
Opaque Elements	**90.1-2004**	**90.1-2007**	**189-P**
Roofs			
Insulation Entirely Above Deck	R-15ci	R-20ci	R-35ci
Metal Buildings	R-19	R-13 + R-19	R-30 + R-10ci
Attic and Other	R-38	R-38	R-60
Walls, Above Grade			
Mass	R-11.4ci	R-15.2ci	R-20ci
Metal Building	R-13 + R-13	R-13 + R-13	R-13 + R-10ci
Steel Framed	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-10ci
Wood Framed and Other	R-13	R-13 + R-7.5ci	R-13 + R-10ci

Table 6 – Commercial opaque envelope requirements for Climate Zone 6 (Minneapolis, Maine).

	Non-residential Buildings		
Opaque Elements	**90.1-2004**	**90.1-2007**	**189-P**
Roofs			
Insulation Entirely Above Deck	R-15ci	R-20ci	R-35ci
Metal Buildings	R-19	R-13 + R-19	R-30 + R-10ci
Attic and Other	R-38	R-38	R-60
Walls, Above Grade			
Mass	R-11.4ci	R-15.2ci	R-20ci
Metal Building	R-13 + R-13	R-13 + R-13	R-13 + R-10ci
Steel Framed	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-10ci
Wood Framed and Other	R-13	R-13 + R-7.5ci	R-13 + R-10ci

Table 7 – Commercial opaque envelope requirements for Climate Zone 7 (northern MN, Canada).

	Non-residential		
Opaque Elements	**90.1-2004**	**90.1-2007**	**189-P**
Roofs			
Insulation Entirely Above Deck	R-20ci	R-20ci	R-35ci
Metal Buildings	R-13 + R-19	R-16 + R-19	R-30 + R-10ci
Attic and Other	R-38	R-49	R-60
Walls, Above Grade			
Mass	R-13.3ci	R-15.2ci	R-20ci
Metal Building	R-13 + R-13	R-13 + R-13	R-13 + R-10ci
Steel Framed	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-10ci
Wood Framed and Other	R-13 + R-7.5ci	R-13 + R-15.6ci	R-13 + R-10ci

Table 8 – Commercial opaque envelope requirements for Climate Zone 8 (northern Alaska).

insulating sheathing.

3. As we seek ever greater levels of "greenness" in the building construction sector, greater levels of energy efficiency must be delivered. The insulation values proposed for Standard 189 again represent minimums. These minimums may still be insufficient to accomplish goals of "net zero energy" or "carbon neutral" building performance without significant on-site power generation, co-generation, or other techniques.
4. Building construction systems using highly conductive materials (steel framing and metal buildings) have significant greater needs for thermal isolation between conditioned and unconditioned spaces.

This increase in overall insulation levels reflects an ever-growing awareness that building envelope decisions are the starting point for all other decisions that impact overall building energy performance (HVAC, lighting, water, etc.) These values also reflect the understanding that envelope decisions often have the longest planning (life) cycle when compared to other building systems.

RESIDENTIAL BUILDINGS

The standards referenced above also address minimum requirements for high-rise and mid-rise residential buildings (every residential structure except low-rise one- and two-family dwellings). This would include apartment buildings, hotels, dormitories, and other similar buildings. *Tables 9* through *16* show the evolution of minimum insulation levels for these building types from ASHRAE 90.1-2004 to Standard 189-P.

GENERAL OBSERVATIONS REGARDING MINIMUM INSULATION REQUIREMENTS FOR RESIDENTIAL BUILDINGS

Again we note that minimum insulation levels have been increased across the board for all construction types in all climate zones. The more severe the climate (from either a heating or cooling perspective), the greater the increase in minimum insulation levels. In cooling-dominated climates, there is an increased focus on suppressing heat gain from roofs with greater levels of insulation. In heating-dominated climates, improving both walls and roofs is required. Again, these are minimum values. Those seeking superior energy performance would merely use these values as the starting point for achieving their performance objectives.

SEMI-HEATED BUILDINGS

The standards referenced above also govern the minimum insulation requirements for semi-heated spaces. While one might at first give little concern to these building types, we note that, due to the typical life expectancy of buildings, changes of occupancy and use classification often occur. These building types are frequently converted into condominiums or retail space or some other use. Many of the conversions focus on the use and layout of interior space and retain the building envelope "as is." As the planning cycle for buildings lengthens, there is a greater likelihood of renovation or change of use.

Tables 17 through *24* show the evolution of minimum insulation levels for semi-heated (semi-conditioned) buildings as defined by these standards.

	Residential Buildings (except low-rise)		
Opaque Elements	**90.1-2004**	**90.1-2007**	**189-P**
Roofs			
Insulation Entirely Above Deck	R-15ci	R-20ci	R-25ci
Metal Buildings	R-19	R-19	R-19 + R-10
Attic and Other	R-38	R-38	R-49
Walls, Above Grade			
Mass	R-5.7ci	R-5.7ci	R-7.6ci
Metal Building	R-13	R-13	R-13 + R-5ci
Steel Framed	R-13	R-13	R-13 + R-5ci
Wood Framed and Other	R-13	R-13	R-13 + R-3.8ci

Table 9 – Residential opaque envelope requirements for Climate Zone 1 (essentially Miami and the islands).

	Residential Buildings (except low-rise)		
Opaque Elements	**90.1-2004**	**90.1-2007**	**189-P**
Roofs			
Insulation Entirely Above Deck	R-15ci	R-20ci	R-25ci
Metal Buildings	R-19	R-19	R-19 + R-10
Attic and Other	R-38	R-38	R-49
Walls, Above Grade			
Mass	R-5.7ci	R-7.6ci	R-9.5ci
Metal Building	R-13	R-13	R-13 + R-10ci
Steel Framed	R-13	R-13 + R-7.5ci	R-13 + R-10ci
Wood Framed and Other	R-13	R-13	R-13 + R-3.8ci

Table 10 – Residential opaque envelope requirements for Climate Zone 2 (primarily the Gulf Coast) .

	Residential Buildings (except low-rise)		
Opaque Elements	**90.1-2004**	**90.1-2007**	**189-P**
Roofs			
Insulation Entirely Above Deck	R-15ci	R-20ci	R-25ci
Metal Buildings	R-19	R-19	R-19 + R-10
Attic and Other	R-38	R-38	R-49
Walls, Above Grade			
Mass	R-7.6ci	R-9.5ci	R-11.4ci
Metal Building	R-13	R-13 + R-13	R-13 + R-10ci
Steel Framed	R-13 + R-3.8ci	R-13 + R-7.5ci	R-13 + R-10ci
Wood Framed and Other	R-13	R-13	R-13 + R-3.8ci

Table 11 – Residential opaque envelope requirements for Climate Zone 3 (Southeast, most of CA).

	Residential Buildings (except low-rise)		
Opaque Elements	**90.1-2004**	**90.1-2007**	**189-P**
Roofs			
Insulation Entirely Above Deck	R-15ci	R-20ci	R-25ci
Metal Buildings	R-19	R-13 + R-13	R-19 + R-10
Attic and Other	R-38	R-38	R-49
Walls, Above Grade			
Mass	R-9.5ci	R-11.4ci	R-13.3ci
Metal Building	R-13	R-13 + R-13	R-13 + R-10ci
Steel Framed	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-10ci
Wood Framed and Other	R-13	R-13 + R-3.8ci	R-13 + R-7.5ci

Table 12 – Residential opaque envelope requirements for Climate Zone 4 (Virginia, St. Louis, etc.).

	Residential Buildings (except low-rise)		
Opaque Elements	**90.1-2004**	**90.1-2007**	**189-P**
Roofs			
Insulation Entirely Above Deck	R-15ci	R-20ci	R-25ci
Metal Buildings	R-19	R-13 + R-13	R-19 + R-10
Attic and Other	R-38	R-38	R-49
Walls, Above Grade			
Mass	R-11.4ci	R-13.3ci	R-15.2ci
Metal Building	R-13 + R-13	R-13 + R-13	R-13 + R-10ci
Steel Framed	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-10ci
Wood Framed and Other	R-13	R-13 + R-7.5ci	R-13 + R-10ci

Table 13 – Residential opaque envelope requirements for Climate Zone 5 (up to Chicago).

	Residential Buildings (except low-rise)		
Opaque Elements	**90.1-2004**	**90.1-2007**	**189-P**
Roofs			
Insulation Entirely Above Deck	R-15ci	R-20ci	R-30ci
Metal Buildings	R-19	R-13 + R-19	R-30 + R-6ci
Attic and Other	R-38	R-38	R-49
Walls, Above Grade			
Mass	R-11.4ci	R-15.2ci	R-20ci
Metal Building	R-13 + R-13	R-13 + R-13	R-13 + R-10ci
Steel Framed	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-10ci
Wood Framed and Other	R-13 + R-3.8ci	R-13 + R-7.5ci	R-13 + R-10ci

Table 14 – Residential opaque envelope requirements for Climate Zone 6 (Minneapolis, Maine).

	Residential Buildings (except low-rise)		
Opaque Elements	**90.1-2004**	**90.1-2007**	**189-P**
Roofs			
Insulation Entirely Above Deck	R-15ci	R-20ci	R-35ci
Metal Buildings	R-19	R-13 + R-19	R-30 + R-10ci
Attic and Other	R-38	R-38	R-60
Walls, Above Grade			
Mass	R-13.3ci	R-15.2ci	R-20ci
Metal Building	R-13 + R-13	R-13 + R-13	R-13 + R-18.8ci
Steel Framed	R-13 + R-7.5ci	R-13 + R15.6ci	R-13 + R-18.8ci
Wood Framed and Other	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-10ci

Table 15 – Residential opaque envelope requirements for Climate Zone 7 (northern MN, Canada).

	Residential Buildings (except low-rise)		
Opaque Elements	**90.1-2004**	**90.1-2007**	**189-P**
Roofs			
Insulation Entirely Above Deck	R-20ci	R-20ci	R-35ci
Metal Buildings	R-13 + R19	R-13 + R-19	R-30 + R-10ci
Attic and Other	R-38	R-49	R-60
Walls, Above Grade			
Mass	R-15.2ci	R-25ci	R-31.3ci
Metal Building	R-13 + R-13	R-13 + R-16	R-13 + R-22.4ci
Steel Framed	R-13 + R-10ci	R-13 + R18.8ci	R-13 + R-21.9ci
Wood Framed and Other	R-13 + R-7.5ci	R-13 + R-15.6ci	R-13 + R-18.8ci

Table 16 – Residential opaque envelope requirements for Climate Zone 8 (northern Alaska).

GENERAL OBSERVATIONS REGARDING MINIMUM INSULATION REQUIREMENTS FOR SEMI-HEATED BUILDINGS

Some of the most significant increases in minimum insulation levels are those required for semi-heated spaces. In each climate zone and for each building type minimum roof and wall insulation levels have significantly increased. Continuous insulation levels have increased for walls and roofs, especially when highly conductive building systems are employed.

BUILDING ENVELOPES "BEYOND THE CODE"

These opaque elements of the building envelope are just one important aspect of building envelope performance. Similar attention and improvements have been made in the area of fenestration and air sealing. But we must recognize that there is a dramatic difference in building *to* the code and building *beyond* the code.

The shaded section of the above tables shows the insulation values in Standard 189, the minimum requirements for green buildings. As "sustainability" as a project objective becomes more commonplace, even greater emphasis must be placed on building envelope performance.

There are practical constraints and challenges in building "beyond the code." The challenges may generally be described as "a change to business as usual." Some of these changes may be reflected in the following typical building details:

1. Increased above-deck roof insulation levels may require rethinking of typical flashing widths and details.
2. Increased attic insulations may necessitate raised-heel trusses to accommodate greater insulation thicknesses.

3. Increased wall R-values may make typical 2 x 4 framing obsolete, opting now for 2 x 6 or increased use of wall sheathing.
4. Increased wall R-values will necessitate thicker walls, possibly changing how we handle window/wall interfaces and water management.
5. Increased roof and wall R-values for metal buildings may necessitate a change to how we handle thermal bridging and thermal isolation in highly conductive systems.
6. Window and door detailing in mass wall constructions may need to be revised to handle slightly increased continuous insulations. And in some climates, wall insulation will be required for the first time, necessitating a new "typical" wall construction system and detailing.
7. Steel framing details will have to be revisited to now accommodate greater continuous insulation thicknesses.

These are just a few of the probable changes to "typical construction" that will result from a renewed focus on energy efficiency and superior building envelope performance.

So are these really challenges? Many buildings have already been built that incorporate these levels of insulation and more. Since the late 1970s we have been aware of the fact that the first line of defense in building energy efficiency is to improve insulation systems and their performance. From home weatherization to improvements in minimum energy codes, improved roof, attic, and wall insulation performance has (again) taken on renewed focus.

	Semi-heated		
Opaque Elements	**90.1-2004**	**90.1-2007**	**189-P**
Roofs			
Insulation Entirely Above Deck	NR	R-3.8ci	R-5ci
Metal Buildings	NR	R-6	R-13
Attic and Other	NR	R-13	R-19
Walls, Above Grade			
Mass	NR	NR	R-5.7ci
Metal Building	NR	R-13	R-13
Steel Framed	NR	NR	R-13
Wood Framed and Other	NR	NR	R-13

Table 17 – Semi-heated opaque envelope requirements for Climate Zone 1 (essentially Miami and the Islands).

	Semi-heated		
Opaque Elements	**90.1-2004**	**90.1-2007**	**189-P**
Roofs			
Insulation Entirely Above Deck	R-3.8ci	R-3.8ci	R-5ci
Metal Buildings	R-6	R-10	R-19
Attic and Other	R-13	R-13	R-19
Walls, Above Grade			
Mass	NR	NR	R-5.7ci
Metal Building	R-6	R-13	R-19
Steel Framed	NR	R-13	R-13 + R-3.8ci
Wood Framed and Other	NR	R-13	R-13 + R-3.8ci

Table 18 – Semi-heated opaque envelope requirements for Climate Zone 2 (primarily the Gulf Coast) .

	Semi-heated		
Opaque Elements	**90.1-2004**	**90.1-2007**	**189-P**
Roofs			
Insulation Entirely Above Deck	R-3.8ci	R-5ci	R-7.6ci
Metal Buildings	R-10	R-10	R-19
Attic and Other	R-13	R-19	R-30
Walls, Above Grade			
Mass	NR	NR	R-5.7ci
Metal Building	R-6	R-13	R-19
Steel Framed	NR	R-13	R-13 + R-3.8ci
Wood Framed and Other	R-13	R-13	R-13 + R-3.8ci

Table 19 – Semi-heated opaque envelope requirements for Climate Zone 3 (Southeast, most of CA).

	Semi-heated		
Opaque Elements	**90.1-2004**	**90.1-2007**	**189-P**
Roofs			
Insulation Entirely Above Deck	R-3.8ci	R-5ci	R-7.6ci
Metal Buildings	R-10	R-10	R-19
Attic and Other	R-13	R-19	R-30
Walls, Above Grade			
Mass	NR	NR	R-5.7ci
Metal Building	R-10	R-13	R-19
Steel Framed	R-13	R-13	R-13 + R-3.8ci
Wood Framed and Other	R-13	R-13	R-13 + R-3.8ci

Table 20 – Semi-heated opaque envelope requirements for Climate Zone 4 (Virginia, St. Louis, etc.).

	Semi-heated		
Opaque Elements	**90.1-2004**	**90.1-2007**	**189-P**
Roofs			
Insulation Entirely Above Deck	R-5ci	R-7.6ci	R-10ci
Metal Buildings	R-10	R-13	R-19
Attic and Other	R-19	R-19	R-30
Walls, Above Grade			
Mass	NR	R-5.7ci	R-7.6ci
Metal Building	R-11	R-13	R-19
Steel Framed	R-13	R-13	R-13 + R-3.8ci
Wood Framed and Other	R-13	R-13	R-13 + R-3.8ci

Table 21 – Semi-heated opaque envelope requirements for Climate Zone 5 (up to Chicago).

	Semi-heated		
Opaque Elements	**90.1-2004**	**90.1-2007**	**189-P**
Roofs			
Insulation Entirely Above Deck	R-5ci	R-10ci	R-15ci
Metal Buildings	R-10	R-16	R-19
Attic and Other	R-19	R-30	R-38
Walls, Above Grade			
Mass	NR	R-5.7ci	R-9.5ci
Metal Building	R-13	R-13	R-19
Steel Framed	R-13	R-13	R-13 + R-3.8ci
Wood Framed and Other	R-13	R-13	R-13 + R-3.8ci

Table 22 – Semi-heated opaque envelope requirements for Climate Zone 6 (Minneapolis, Maine).

	Semi-heated		
Opaque Elements	**90.1-2004**	**90.1-2007**	**189-P**
Roofs			
Insulation Entirely Above Deck	R-5ci	R-10ci	R-15ci
Metal Buildings	R-10	R-16	R-19
Attic and Other	R-19	R-30	R-38
Walls, Above Grade			
Mass	NR	R-7.6ci	R-11.4ci
Metal Building	R-13	R-13	R-19
Steel Framed	R-13	R-13	R-13 + R-3.8ci
Wood Framed and Other	R-13	R-13	R-13 + R-3.8ci

Table 23 – Semi-heated opaque envelope requirements for Climate Zone 7 (northern MN, Canada).

	Semi-heated		
Opaque Elements	**90.1-2004**	**90.1-2007**	**189-P**
Roofs			
Insulation Entirely Above Deck	R-10ci	R-15ci	R-20ci
Metal Buildings	R-16	R-19	R-13 + R-19
Attic and Other	R-30	R-30	R-38
Walls, Above Grade			
Mass	R-5.7ci	R-9.5ci	R-13.3ci
Metal Building	R-13	R-13	R-13 + R-7.5ci
Steel Framed	R-13	R-13 + R-3.8ci	R-13 + R-7.5ci
Wood Framed and Other	R-13	R-13	R-13 + R-3.8ci

Table 24 – Semi-heated opaque envelope requirements for Climate Zone 8 (northern Alaska).

WHAT DO THESE CHANGES MEAN TO ROOFING CONSULTANTS AND OTHER BUILDING PROFESSIONALS?

First, we must remember that the code is a minimum, and the country's minimum code has changed. Every building envelope should meet the minimum insulations now required by ASHRAE Standard 90.1-2007.

Secondly, architects, specifiers, engineers and other certifying professionals need to ensure that all drawings and contract documents show at least these levels of minimum insulation. "Typical" specifications need to be revised and updated to reflect these new requirements.

Renovations to existing buildings covered under the code need to meet these new roof, attic, and wall insulation levels. If practical constraints limit the ability to meet these values, then improvements will be required elsewhere in the project (HVAC, service water, etc.) to meet the code performance requirements.

ECONOMIC OPPORTUNITIES BEYOND THE CODE

It is often difficult to imagine "economic opportunities" in a time when the building economy is suffering so badly. However, superior energy efficiency creates such opportunities.

Energy efficiency as a market force is gaining momentum. And the growing desire for "sustainability" in the building sector adds fuel to the increased efficiency demand. This creates new opportunities for differentiation in a widely homogeneous marketplace.

Building owners have already begun to see the value of superior energy efficiency and the marketing power of sustainable projects. The Building Owners and Managers Association (BOMA) has

widely marketed its internal analyses of the value of increased energy efficiency – showing increased property value, ability to secure higher rental values, higher market resale value and increased tenant desirability.

Many architects are trying to reposition their practices to focus on sustainability. As such, the insulation values shown in ASHRAE Standard 189-P will be a new "starting point" – an even higher efficiency bar to meet if seeking to demonstrate truly sustainable projects. The AIA has been promoting its "carbon neutral" goal for 2030. To get there, buildings must deliver dramatically higher levels of energy efficiency, with Standard 189-P as a starting place. As the marketplace for sustainable design continues to grow, energy performance even beyond the minimums implied by ASHRAE Standard-189-P will become more commonplace.

As the marketplace for more energy efficient projects increases, energy performance becomes more of a standard expectation, rather than an optional nicety. This is especially true now, in a time of such uncertainty about our energy security and energy futures. We already see an increased demand for home energy ratings in real estate transactions. Commercial property owners are being asked for Energy Star and other energy performance certifications. Many are using energy upgrades to make stale properties more desirable in tough economic times.

Recognize that these energy improvements are capital investments – permanent improvements to infrastructure. As energy costs rise, these investments act to dampen the rate of increase in O&M costs and work as a hedge against deflation. Energy bills become more predictable, making the building less "responsive" to the wild swings in energy prices we have recently seen.

CONCLUSIONS

Market forces for improved building energy efficiency are growing. Increased demand for "sustainability" in the buildings sector is further fueling the demand for ever greater levels of energy efficiency beyond code minimums. This demand is impacting all segments of the commercial building marketplace.

ASHRAE Standard 90.1-2007 has established new minimum levels of commercial building energy efficiency. ASHRAE Standard 189-P has established even greater levels of efficiency minimums when seeking to develop "green buildings" in concert with these sustainability objectives.

Building owners, architects and developers must evaluate their current and future project objectives against these market forces and new minimum levels of energy performance. Certifying professionals (engineers, architects, etc.) must ensure that all new specifications meet these new code minimums. Standard project specifications must be reviewed and updated to reflect these new minimums.

All energy performance begins with the building envelope. Projects with green building or sustainability objectives should consider the values in ASHRAE Standard 189-P as the new minimums for roof, attic, and wall insulation necessary to achieve beyond code performance.

NOTES