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The Consultant's Role in Reroofing: Remember Energy Efficiency

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Doorways to the *Future*

ABSTRACT

Roof consultants have a great opportunity to provide building owners with energy-saving opportunities by evaluating and recommending cost-effective, energy-efficient measures to be implemented when reroofing. Although the energy performance of the roof in new construction is considered, a significant number of older buildings are more than likely under-insulated. In many cases, energy codes do not address the issues of insulation or energy efficiency as they apply to reroofing. This presentation will examine the energy requirements of existing energy codes, including a "beyond the code" cost benefit analysis for insulation upgrades when reroofing.

SPEAKER

LORRAINE ROSS is president of Intech Consulting Inc., a building code and technical consulting company located in Gulfport, FL. She is deeply involved in the continuing development of the Florida Building Code and the International Building, Residential, and Energy Conservation Codes, and in product approval processes. Lorraine remains active in roofing standards and technology through memberships in NRCA, ASTM, CSI, and RCI. Ross is also vice president of BRB Code Educators Inc., a building code and technical training company through which she has presented seminars on a wide range of roofing and energy topics to code enforcement personnel, contractors, specifiers, consultants, and building product manufacturer organizations.

Lorraine started her career in the construction industry in 1984 and gained experience in manufacturing, technical services, and energy and environmental regulations while employed by Celotex Corporation, and later representing clients before Congress and the U.S. Department of Energy and the U.S. Environmental Protection Agency while a partner at Alcalde & Fay, a government affairs company based in Washington, DC.

The Consultant's Role in Reroofing: Remember Energy Efficiency

INTRODUCTION

Roof consultants have a great opportunity to provide building owners with energy-saving opportunities by evaluating and recommending cost-effective, energy-efficiency measures to be implemented when reroofing. Although the energy performance of the roof in new construction is considered, a significant number of older buildings are more than likely under-insulated. In many cases, building codes or energy codes do not address the issue of insulation or energy efficiency as they apply to reroofing. The situation is also made more complicated because local jurisdictions may not require permitting or inspections of reroofing projects. This presentation will examine the energy requirements of existing energy codes, including a "beyond the code" cost benefit analysis for insulation upgrades when reroofing.

NEW BUILDINGS VS. EXISTING BUILDINGS

It is relatively easy to specify roof insulation for new construction. Most roof consultants, architects, designers, and specifiers rely on ASHRAE 90.1, which describes the minimum (and I do emphasize "minimum") insulation levels to be used in low-slope commercial buildings based on climate zone. Of course, the version of ASHRAE 90.1 will vary by code jurisdiction.

Virtually all state and national energy codes address new construction and the roof insulation levels are either described prescriptively, or they may be factored into a performance-type compliance method, where certain trade-offs are allowed; e.g., increasing envelope insulation as a way to enlarge the window area.

A variety of sources can be consulted to determine the "optimum" versus minimum roof insulation values that will produce an economically justified roof R-value. For example, NRCA's SpecRight Program with the EnergyWise Calculator allows the user to create scenarios where the insulation value and roof reflectivity are varied, resulting in an estimated energy cost savings for each proposed roof assembly. The Revised Oak Ridge Calculator allows the user to estimate the reduction in Peak Load along with a static analysis of energy savings. Both of these calculators look at the roof specifically. If information is desired on the effect of increasing roof insulation and/or roof reflectivity on the energy efficiency of the entire building, then use a whole-building analysis, such as DOE 2.1 Building Energy Simulation Software. These types of calculators are much more complicated and will calculate the hourly energy use and energy cost of a commercial or residential building given information about the building's climate, construction, operation, utility rate schedule and heating, ventilating, and air-conditioning (HVAC) equipment.

Unfortunately, no clear direction is available when it comes to energy analysis and recommendations when reroofing activities are planned. The first decision on when to tear-off rather than recover can be complicated, and adding the decision to improve the energy efficiency of the roof is rarely the first thought in this equation. Energy codes are, at best, confusing and somewhat vague in their requirements for reroofing. Yet, this market holds a significant key for directly impacting the operating costs for building owners, reducing the nation's dependence on fossil fuels, and improving our environmental profile.

THE OPPORTUNITY

In August of 2000, Lawrence Berkeley Laboratory estimated that commercial building owners spent $100 billion annually in energy costs. According to the U.S. Energy Information Administration's periodic Commercial Buildings Energy Consumption Survey (CBECS), there were 4.7 million commercial buildings with 67.3 billion square feet of commercial floor space in the United States. In 2000, about 17 percent of total U.S. energy (about 5.7 quadrillion BTUs) was consumed in the commercial sector.

The target population for the CBECS consists of all commercial buildings in the United States with more than 1,000 square feet of floor space. A commercial building, defined by CBECS, is an enclosed structure with more than 50 percent of its floor space devoted to activities that are not residential, industrial, or agricultural. The sector includes service businesses such as retail and wholesale stores, hotels and motels, restaurants, and hospitals, as well as a wide range of buildings that would not be considered "commercial" in a traditional economic sense, such as

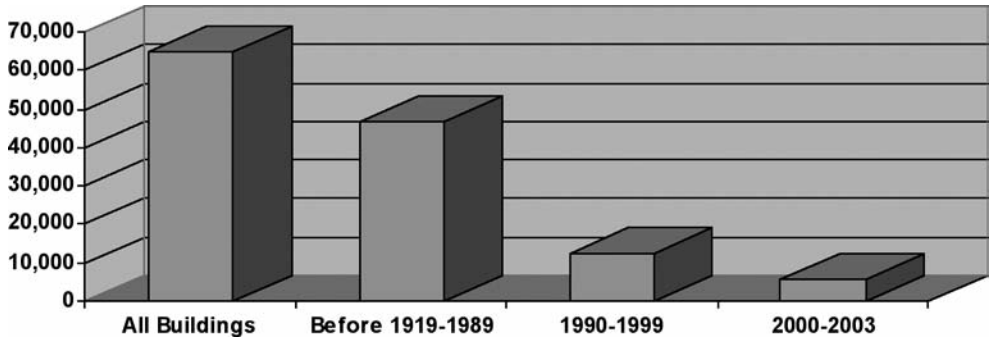

Figure 1 – Age distribution of commercial floor space (million square feet) in 2003.

public schools, correctional institutions, and religious and fraternal organizations. Excluded from the sector are the goods-producing industries: manufacturing, agriculture, mining, forestry and fisheries, and construction.

The age distribution of the existing commercial building floorspace in 2003 is depicted in *Figure 1*.

When one considers the weakness of energy codes prior to 1989 (the last update in roof insulation requirements of ASHRAE 90.1 for new construction), the energy saving opportunity of retrofitting these buildings becomes apparent.

BOMA International has embarked on a significant program called the BOMA Energy Efficiency Program. This program presents the financial and environmental benefits from improving the energy efficiency of buildings.

For example, investing $1/sq ft in energy improvement projects that deliver just a 10% improvement in energy efficiency will deliver a potential increase in Net Operating Income (NOI) of $200,000 and a potential increase in Net Asset Value of $2.5 million (based on an assumed energy expense of $2/sq ft and a capitalization rate of 8% for a 1 million square foot building portfolio).

On the environmental side, reducing the energy consumption of a typical 1 million square foot portfolio by only 10% results in positive environmental benefits:

- Is equivalent to planting 40,360 trees.
- Generates $1.2 billion worth of oxygen.
- Controls $1.3 billion worth of soil erosion.
- Recycles $1.5 billion worth of water.
- Provides $2.5 billion worth of air pollution control.
- Removes 4,736 cars from the road for 1 year.

CURRENT ENERGY CONSIDERATIONS IN REROOFING

A number of factors contribute to the energy requirements of a reroofing project: building type, use, and location (federal, state, or local energy code requirements, usually given as a total R-value or U-value for the roof/ceiling assembly). Occasionally these factors are supplemented with "in-house" company thermal efficiency standards.

Energy Code Weaknesses Related to Reroofing

Questions abound as to when energy codes apply to reroofing projects. For example, in an article written by Loren Snyder, entitled "Re-covering the Roof: Right and Wrong," Tom Hutchinson, RRC, AIA of Hutchinson Design Group explained the need to adhere to the energy code adopted by Chicago:

> *Among other things, the code requires that if a project on an existing building exposes the roof deck, the roof must meet energy standards that often require additional insulation and the use of roofing materials with greater solar reflectivity. In other words, building owners who re-cover their roof instead of performing a tear-off are exempted from Chicago's energy code insulation and reflectivity regulations.*

Presumably, with a re-cover, additional insulation and/or a reflective roof would not be required even if the current roof assembly contained no insulation! The following section explores various standards and a view to positions on improving energy efficiency of the roof during a reroofing project.

ANSI/ASHRAE 90.1-1999 (IP) – Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings

While ASHRAE 90.1-99 is most often cited for energy requirements for new commercial buildings, the application of these R-values or U-values to an existing roof appears to come into play only for building additions or in the case where an unconditioned space is being converted to conditioned space.

2003 International Existing Building Code

The 2003 International Existing Building Code (IEBC) further muddies the water. Reroofing is classified as a Level 1 Alteration, which is governed by Chapter 5. Section 503.3 addresses compliance with the International Ener-

gy Code:

> ***503.3 Materials and methods.***
>
> *All new work shall comply with materials and methods requirements in the ICC Electrical Code, International Building Code, International Energy Conservation Code, International Mechanical Code, and International Plumbing Code, as applicable, that specify material standards, detail of installation and connection, joints, penetrations, and continuity of any element, component, or system in the building.*

Whether this section apples to improving the insulation level in the building is subject to interpretation. For example, it is a given that the reroofing materials themselves must comply with the current code. Enforcement of adding sufficient levels of insulation to an existing building seems to vary by jurisdiction. It must also be noted that the International Existing Building Code is a relatively new code, introduced in the 2003 versions of the I-Codes. It has not been adopted widely at this point in time.

2006 International Energy Conservation Code

Similarly, the 2006 International Energy Conservation Code (IECC) offers no clarity when it comes to reroofing projects.

> ***101.4 Applicability.***
>
> ***101.4.1 Existing buildings.***
>
> *Except as specified in this chapter, this code shall not be used to require the removal, alteration, or abandonment of, nor prevent the continued use and maintenance of, an existing building or building system lawfully in existence at the time of adoption of this code.*
>
> ***101.4.3 Additions, alterations, renovations, or repairs.***
>
> *Additions, alterations, renovations, or repairs to an existing building, building system, or portion thereof shall conform to the provisions of this code as they relate to new construction without requiring the unaltered portion(s) of the existing building or building system to comply with this code.*
>
> *Additions, alterations, renovations, or repairs shall not create an unsafe or hazardous condition or overload existing building systems.*
>
> *Exception: The following need not comply, provided the energy use of the building is not increased:*
>
> 1. *Storm windows installed over existing fenestration.*
> 2. *Glass-only replacements in an existing sash and frame.*
> 3. *Existing ceiling, wall, or floor cavities exposed during construction provided that these cavities are filled with insulation.*
> 4. *Construction where the existing roof, wall, or floor cavity is not exposed.*

The adoption of the IEBC and the IECC are not widespread. Many jurisdictions take the position similar to the Chicago interpretation described by Mr. Hutchinson, i.e., if the deck is not exposed, then there is no need to bring the roof up to current code. Examples from other jurisdictions include:

Miami Dade County

The Miami Dade Commercial Re-roof Form, issued in 2005 by Miami Dade County, Florida, is shown in the box below.

> The following applicable statements are required to be completed when applying for commercial reroofing permit applications.
>
> Job Address: _____
>
> Process Number: _____
>
> Is there insulation in the existing roof system? Yes No
>
> If yes, then I attest that the insulation to be installed in the proposed roofing system shall have the same thickness and R-Value as the existing insulation.

State of Washington

The State of Washington Energy Code requires the addition of roof insulation in cases of tear-off only:

> ***Tear-off and Reroof***
>
> *Per Section 1132.1 of the 2003 Washington State Nonresidential Energy Code, installation of insulation is required if the roofing is torn down to the bare deck. If the roof is torn down to the bare deck, inspection of the deck is also required.*
>
> *Per Section 1310.2, the insulation requirements are:*
>
> 1. *U=0.10 maximum for the roof assembly, or*
> 2. *Continuous R-9 insulation installed entirely outside of the roof structure, or*
> 3. *R-11 insulation installed inside or within a wood roof structure, or*
> 4. *R-10 insulation installed inside or within a metal roof structure.*
>
> *A final inspection and approval shall be obtained from the building official when the*

reroofing is complete.

State of California

The State of California takes a different approach for explaining its 2005 Title 24 Building Energy Efficiency Standards Requirements for reroofing projects:

> ***Q8.*** *What are the cool roof requirements for reroofing projects?*
>
> ***A.*** *For reroofing of nonresidential, low-sloped roofs over conditioned space, if more than 50 percent of the roof or more than 20 squares (2,000 square feet) – whichever is less – is being replaced, recovered, or recoated, you must install a qualifying cool roof OR you must provide calculations that show that the heat gain into the building through the new roof will be less than or equal to the heat gain through a cool roof.*

NEW DIRECTION

There is an ever-increasing view in the market that minimum energy standards are just not enough to address the rising energy costs faced by today's building owners and operators. Evidence for these "above the code" programs is illustrated by ASHRAE's *Advanced Energy Design Guides*. A description of the Advanced Building Design for Small Office Buildings states:

> *For developing energy-efficient buildings, the* Advanced Energy Design Guide *provides a sensible approach by including practical products and readily-available, "off-the-shelf" technology.* The Guide *offers you all the tools you need to create an energy-efficient building where the owners will see a 30 percent energy savings compared to buildings that only meet the minimum requirements of Standard 90.1.*

Additionally, many states and local governments are enacting their own climate change initiatives that have as a major component increasing the energy efficiency of buildings.

The path forward in the effort to improve the energy efficiency of existing buildings was best summed up by Don Olson, Minnesota Public Radio, in a piece entitled, "Energy Conservation: Dull, Old, Unloved, and Still the Best Way to Save Energy Dollars."

> *The biggest source of energy for the near future is not coal, natural gas, solar, or wind. The biggest source, its proponents say, is conservation or efficiency. And no, they argue that doesn't mean shivering in the winter and sweating in the summer. Efficiency, the experts say, is about cutting energy waste without reducing comfort or productivity. And they say they have the numbers to prove how much energy can be saved. However conservation proponents struggle to get the public's attention because so many are preoccupied with interesting new alternative energy sources."*
>
> **June 28, 2006 broadcast**
> **Minnesota Public Radio**

TOOLS TO IMPROVE ENERGY EFFICIENCY OF EXISTING BUILDINGS

If no specific energy requirements exist for a reroofing project, the choice to upgrade the insulation is left to the designer, who must then convince the building owner that the increased costs are justified. Many roof consultants are familiar with a variety of calculators that can assess the estimated cost savings in upgrading the energy efficiency of an existing roof. The National Roofing Contractors Association (NRCA) has launched an educational program called SpecRight, whose tag line is "Save your energy. You've found the right roof." Additional information about SpecRight, including training sessions and a great deal of resource material, can be found at **www.specright.net.**

Once the potential energy savings for the upgrade have been calculated, a bigger task may lie ahead in convincing the building owner that the upgrade is financially valuable. A rigid Return on Investment (ROI) policy may prohibit an improvement in the current energy efficiency level of a building. An effort to gain better understanding of financial aspects of energy efficiency will help in the roof consultant's efforts to deliver a quality, energy-efficient roof – one that exceeds outdated minimum standards.

Two important programs are worth exploring to assist in selling the energy-efficiency improvements in a reroofing project.

BEEP: BOMA Energy Efficiency Program

Recognizing the importance of constructing and operating energy-efficient buildings, the Building Owners and Managers Association (BOMA), whose 19,000-plus members own or manage more than 9 billion square feet of commercial properties in North America and abroad, created a new initiative called BEEP: BOMA Energy Efficiency Program. On its Web site, BOMA gives nine reasons for participation in BEEP :

1. Save energy costs and lower overall occupancy costs in your buildings.
2. Make your buildings more competitive, profitable, and valuable.
3. Improve tenant comfort and satisfaction with better building temperature

control.

4. Lower absenteeism and increase your tenants' productivity, resulting in real cost savings for tenants.
5. Extend equipment life by improving the operations and maintenance of building systems and ensure equipment is operating as designed.
6. Extend the value of financial returns beyond energy savings to improve NOI, asset value, and tenant comfort.
7. Implement low-risk, low-cost strategies to improve energy efficiency with high returns.
8. Positively impact your community and your planet by helping to reduce your industry's role in global warming.
9. Position yourself and the industry as leaders and solution providers to owners and tenants seeking environmental and operational excellence.

A series of six 2-hour Webcasts are available. Seminar 5, Valuing Energy Enhancement Projects and Financial Returns, should be of particular interest to roof consultants and designers.

Seminar 5: Valuing Energy Enhancement Projects and Financial Returns

In this critical class, examine the use of financial metrics and tools to calculate and sell enhancement projects to owners, asset managers, and tenants by highlighting the positive financial and environmental impacts of improved energy performance. Learn how to put energy efficiency in the context of "what's important" to financial decision-makers.

Upon successfully completing this seminar, you'll be able to…

- *Build compelling arguments to sell the financial benefits to senior decision-makers.*
- *Calculate the financial benefits of improvements such as NPV, IRR, ROI, payback, NOI, and asset value.*
- *Calculate the environmental benefits of improvements.*
- *Describe how energy performance improvements benefit tenants, improve comfort, and extend equipment life cycles.*

Another tool to include when approaching a building owner about upgraded energy efficiency is the federal government's tax incentives that were part of the Energy Policy Act of 2005 (EPACT 2005).

The Internal Revenue Service (IRS) has issued guidelines explaining how commercial buildings owners or leaseholders who make their buildings more energy-efficient can qualify for the tax deduction enacted as part of the Energy Policy Act of 2005 (EPACT 2005).

The IRS guidelines provide tax deductions of $1.80 per square foot for owners of commercial buildings that exceed ASHRAE 90.1, "Energy Standard for Buildings Except Low-Rise Residential Buildings" by 50 percent or more. Before claiming the tax deduction, building owners must obtain a certification that the building improvements will reduce energy costs by the required levels. The Department of Energy will develop and maintain a public list of software that building owners can use to calculate energy savings.

In addition to the whole building performance deduction, Congress also provided a partial deduction of 60 cents per square foot for building owners who improve one of the following systems – building envelope, HVAC, or lighting – by a designated percentage set by the IRS in its guidelines. The complete requirements can be found at: **www.energytaxincentives.org/IRS_guidance_comml_bldgs_06_52.pdf**.

CONCLUSIONS

RCI can play a major role in improving the energy efficiency of the existing building stock by considering the impact of improving the energy efficiency of the roof, whether this is accomplished directly through increasing insulation and reflectivity, where justified, or through a more robust whole-building analysis to the reroofing decision. It is clear that "meeting the code" is no longer adequate since so many energy code standards are either outdated or do not directly address reroofing projects. Tools exist to not only assess potential cost savings related to energy efficiency upgrades, but also to present the financial analysis of the upgrades to building owners in a way that they can appreciate, understand, and on which they may act.

Several recommendations for consideration include:

1. When reroofing (tear-off or recover), ensure that the roof, as a minimum, meets ASHRAE 90.1-99 (R-15 for most areas, except southern Florida) or the International Energy Conservation Code. Be aware that ASHRAE is currently proposing raising the minimum levels to R-20.
2. A comparison of ASHRAE 90.1-99 and 2006 International Energy Conservation Code:

While the Climate Zone maps have been harmonized, the minimum "above deck" insulation levels do vary (see *Figure 2* and *Table 1)*.

Remember that these values are minimum levels. Given rising energy costs that are not expected to fall, insulating buildings beyond the minimum levels is a prudent choice.

3. Consider upgrading rooftop HVAC units to higher SEER ratings as part of the reroofing project.

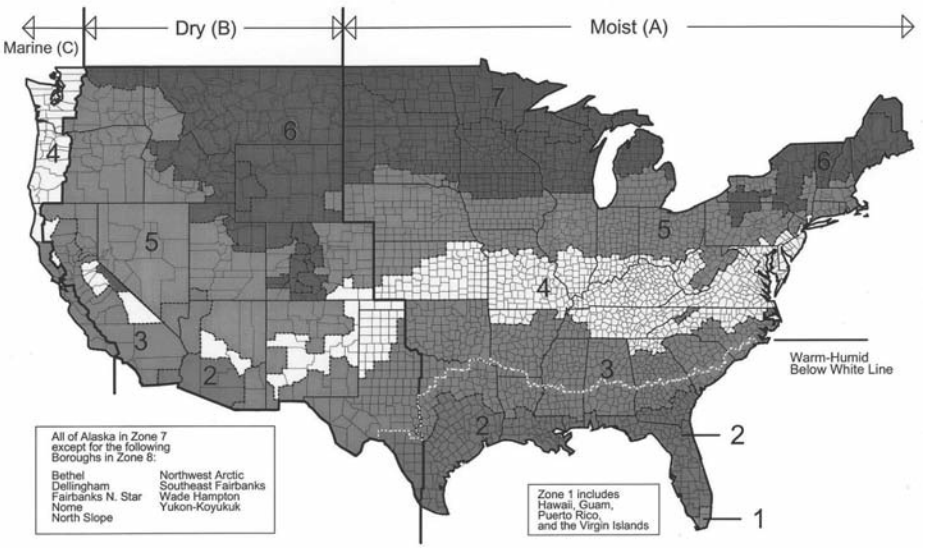

Figure 2 – 2006 International Energy Conservation Code, Figure 301.1 Climate Zones. Note: The climate zones are the same in both 2006 IECC and ASHRAE 90.1-99.

Climate Zone	ASHRAE 90.1-99	2006 IECC	Proposed ASHRAE 90-1
1	15	15	15 (no change)
2	15	15	20
3	15	15	20
4	15	15 (except Marine)	20
5	15	20 (and 4 Marine)	20
6	15	20	20
7	15	25	20
8	20	25	20

Table 1 – Minimum R-values for continuous insulation above the roof deck.