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MEMO FROM THE PRESIDENT

The integrity of the building envelope can significantly affect the energy efficiency of a building. Whether due to poor design, construction or deterioration of exterior components, the building envelope can contribute to significant energy losses. Building envelope restoration projects will not only re-establish the integrity of the building envelope, but can also reduce energy costs. Recent research performed by the Department of Energy indicates that remediation of a problematic building envelope can reduce energy costs by 5% to 36%. With energy costs on a steady rise, the reduction of energy usage can lead to significant cost savings. In general, there are three significant sources of energy loss through the building envelope: air leakage, wet components, and overall thermal resistance.

A significant consideration in establishing budgets for remedial building envelope projects is the potential "payback" time as a result of energy savings. In general, restoration maintenance projects will pay for themselves in approximately one year. Major capital restoration projects in three to four years, and major capital roofing projects in seven to eight years. First and foremost is designing the proper solution. In today's economy, energy savings will have a significant impact.

Jeffrey L. Brittan
Chief Executive Officer

Success Stories of Energy Conservation in Building Envelopes

Spectrum Health

Spectrum Health is one of the nation's top integrated delivery systems in healthcare, and the quality of their hospitals and health plan is nationally recognized. Since this new system of integration was formed in 1997, they have earned more than 40 national awards.

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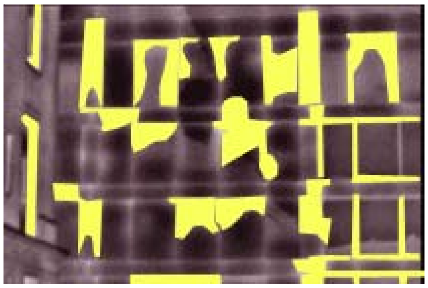
__Profile__:
Exterior Wall Energy Analysis

__Project__:
1976 Building - Blodgett Campus

__Procedures__:
Evaluation, Design Development

Infrared image identifying air leakage at panel joints and thermal loss at perimeter exterior edge detail, identified through the ***StructureScan***TM survey.



Infrared image identifying displaced insulation boards and air leakage at panel joints. Proper remedial cladding procedures will enhance integrity and provide an energy efficient structure.

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Eric J. Seaverson, P.E., Manager, The Restoration Group

With dramatic and continuing increases in energy costs, building owners and facility managers are scrambling to evaluate ways to make new and existing buildings more energy efficient. Most concepts for energy efficiency include lighting usage and more efficient mechanical systems. Although commonly regarded merely as a barrier against moisture, the building envelope is also a key element of energy efficiency, primarily affecting heating and cooling. In addition to making the building envelope more energy efficient, designing and constructing the building envelope in conjunction with the mechanical system will make the heating and cooling of a building significantly more efficient. Otherwise, mechanical systems may be overworked due to an inadequate building envelope. Expansive knowledge and understanding of the building envelope, including material selection and detailing, is necessary to construct an energy efficient, as well as reliable and functional, building envelope.

Energy losses through the building envelope can be attributed to various sources including air leakage, wet insulation, and thermal bridging. The following summarizes the cause of energy loss for each potential source.

Wet, saturated roof insulation is a major cause of energy loss.

To prevent exterior air from entering the interior habitable spaces, building mechanical systems are typically balanced to create a positive pressure (i.e. more air is supplied to the interior than exhausted, pushing air out through openings in the building envelope). Although this is a common practice in the building industry, openings in the building envelope can allow unexpected and significant amounts of air to exit the building, significantly increasing heating/cooling loads. Common air leakage paths include around and through windows/doors, gaps at transitions between walls and floor/roof levels, transitions in cladding, and structural penetrations through the wall system.

Moisture within building envelope components not only leads to premature deterioration of the material, but also decreases the R-value and thermal efficiency.

Moisture within building envelope components, such as insulation, not only leads to premature deterioration of the material, but also decreases the R-value and thermal efficiency of the overall building. Building envelope components can be exposed to moisture from various ways, including condensation and direct water leakage.

Due to budget constraints, and the “out of sight out of mind” concept, roofs are one of the most commonly neglected building envelope components. That said, roofs are also very important for preventing moisture from entering the building and for thermal efficiency. Moisture from condensation within the roof section or bulk water migrating below the membrane significantly decreases the R-value of roof insulation. The majority of water migrating below a roof membrane is typically caused by improper and/or unreliable detailing.

Similarly, condensation and bulk water leakage must be prevented from exposing the insulation to moisture. To prevent condensation from forming within a wall system, a vapor retarder is typically installed. In addition, the wall system must be constructed and detailed to capture and manage bulk water intrusion and divert it to the exterior.

Unlike air leakage which is a direct source of hot or cold exterior air, thermal bridging through the building envelope can also increase the load on the mechanical system. Thermal bridging consists of temperature gradients through system components (such as cold exterior air cooling a window frame, which then cools interior air). Although thermal bridging is typically only attributed to components in the wall system that are “directly” exposed on both the interior and exterior, such as window frames, thermal bridging also occurs in the “field" of the wall system, especially at steel studs which extend through the wall between the insulation.

The building envelope can be designed to increase the energy efficiency in several ways, including reducing/preventing air leakage, preventing and replacing wet insulation, and reducing the effects of thermal bridging. The following summarizes schematic options to increase the thermal efficiency of the building envelope.

As noted above, roofs are often the most neglected building envelope component. Roof replacement is typically not implemented until severe interior leakage is observed. However, due to poor design and/or installation, many roofs experience water leakage soon after construction. In many instances, water leakage through a roof membrane can be unnoticed because a vapor retarder installed at the bottom of the roof system captures the water. The captured water absorbs into the insulation, significantly decreasing the thermal value of the insulation, and also causing premature deterioration of the roof system.

To prevent water migrating into the roof system, a proper design must be prepared and implemented. In most instances, the membrane in the field of the roof does not allow bulk water

Green Roof Technology
"Attention to detail" is critical at flashings and membrane transitions.

leakage. Most instances of water leakage through a roof system is due to unreliable detailing. Roof system manufacturers provide "standard" details for perimeter conditions, which typically have the flashing exposed and terminated on the wall surface, and rely on sealants to prevent water infiltration. In addition to the reliance on sealant, manufacturer details typically do not address leakage around the roof system.

For example, in most instances, roof terminations consist of surface-mounted conditions (exposed termination bars or metal flashing), or reglet-set flashing (small cut in wall system to insert metal flashing). In a brick masonry wall, these types of terminations are not appropriate because water can readily infiltrate through the masonry, bypassing the flashing, and migrate into the insulation (and other roof components). Instead, the design of roof flashing for a masonry (or similar type) wall should incorporate a through-wall flashing that extends through the masonry to capture and divert water out of the wall above the roof system flashing.

To reduce thermal bridging, windows incorporating a design feature called thermally broken window frames. Although not a perfect solution, thermally broken frames decrease the effects of thermal bridging.

Similarly, wall systems can be constructed to reduce thermal bridging effects. With stud wall construction, the insulation can be installed outboard of the wall sheathing in a continuous fashion, which reduces the effect of thermal bridging. Extruded polystyrene rigid insulation board, which does not readily absorb moisture, is required since it will be exposed to moisture that migrates through the cladding system.

The most effective way to increase energy efficiency is to minimize air leakage. One of the more recent considerations in building and energy codes is the requirement to provide an air barrier in the building envelope. The basic theory of air barriers is to prevent interior air from exiting the building and exterior air from entering. During cooling seasons, warm interior air exiting the building is direct heat loss, and cold exterior air entering the building cools the interior air. In both instances, the building mechanical system must compensate for these conditions, increasing the demand of the system, therefore decreasing the overall efficiency.

> ***Energy costs are the driving force for more energy efficient buildings. Knowledge is required to ensure that the building envelope is energy efficient, durable, and functional.***

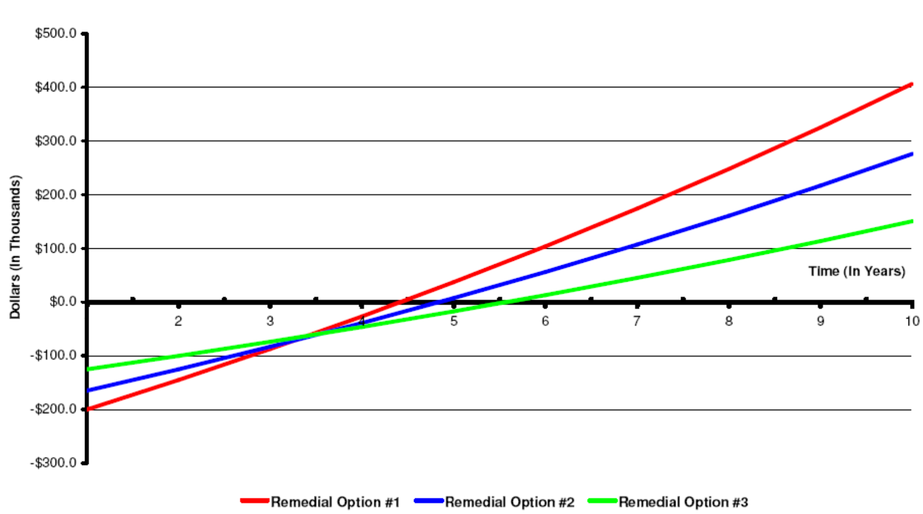
Several types of air barriers exist, ranging from self-adhered membranes, building wraps, and liquid-applied membranes. In general, an air barrier must be continuous around the entire building (including walls and roofs), be continuously supported to resist positive and negative air pressure, openings in the wall system (such as windows) must be integrated with the barrier, and penetrations through the barrier must be sealed.

To increase the energy efficiency of the building envelope, the items discussed above must be considered. Although seemingly easy, there are many design considerations that must be addressed to provide a thermally-efficient, reliable, and functional building envelope. The following summarizes some of the design considerations for new and existing buildings.

Other than increasing the R-value of the wall system, the most effective way to increase energy efficiency is to provide an air barrier. Although introducing the air barrier into the wall system is easy, the majority of air leakage typically occurs at details. The air barrier should not be considered merely as a layer included in the wall system, but as an entire system which includes several materials and details to integrate with adjacent components. Without proper detailing, material selection, and installation of these transitions, the air barrier will not be reliably established.

Another consideration with revising the "conventional" wall system is

Figure 1 - Compounded Cumulative Payback



making the air barrier, vapor retarder, and back-up waterproofing a single component. Introducing a single component requires installing the material on the exterior side of the sheathing so that it can function as a waterproofing layer. However, because the vapor barrier is now located on the outside surface of the wall, the insulation must be shifted to the exterior (in cold climates). Using extruded polystyrene insulation on the exterior of the wall will also reduce thermal bridging in the steel studs. Introducing rigid insulation on the outboard side of the wall studs will increase the wall thickness; however, lack of occupant complaints and energy savings make up for lost square footage. Windows must be properly located and integrated into the thicker wall system to align with the insulation.

Roof system details must be reviewed and properly detailed for project-specific conditions. Although the manufacturer standard section details may work in some instances, transitions and terminations must be designed for reliable protection against water leakage.

When an existing building experiences significant air leakage, it can be difficult to establish a reliable air barrier. The first step is to evaluate the building and determine the source(s) of air leakage. If air leakage is experienced around windows, perimeter sealant can be replaced, but air leakage is typically not eliminated depending on the wall system.

In buildings with prefabricated panels, during construction significant holes can be made in the back-up

Proper remedial design for air barrier, vapor barrier, exterior restoration and cladding are critical elements of energy conservation and building performance.

wall for connections between the panels and the building structure; these holes are typically not sealed during construction and can be significant sources of air leakage. If access is available, the openings may be sealed with spray foam materials around the supports, but because access is typically difficult, air leakage will likely be reduced, but not completely stopped.

The addition of insulation to the walls of an existing building is typically not economically feasible, unless the building will be re-clad for aesthetic reasons or if other significant deficiencies are present.

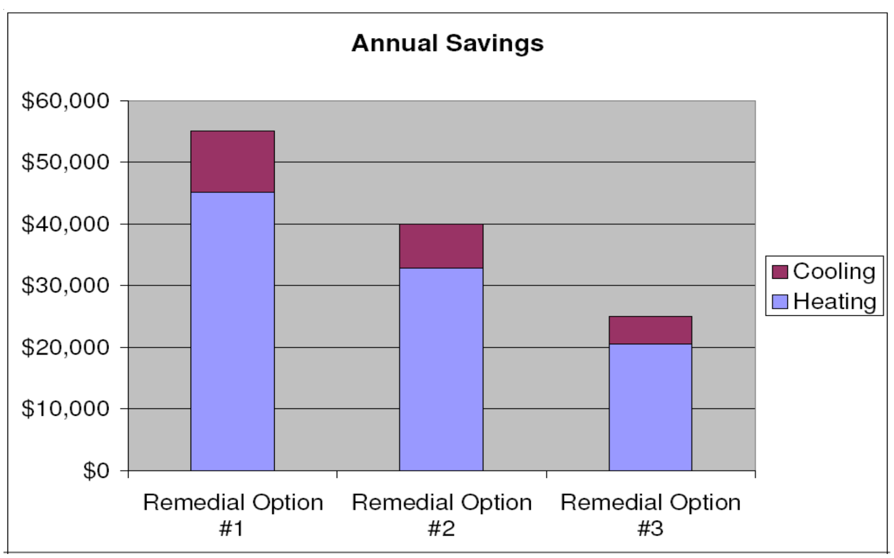
That said, replacement of a roof system can be considered. Thermal scans (***StructureScan***™) of a roof system can be taken to locate wet insulation that reduces energy efficiency, which can be replaced, along with addressing the cause of the leakage. If a significant amount of insulation is wet, complete replacement should be considered, which will not only replace the inefficient wet insulation, but current building codes will require additional insulation. When adding insulation to a roof system, the impact on flashing heights must be thoroughly reviewed and detailed to provide a reliable system, preventing moisture from migrating into the insulation (and building).

Significant energy loss through the building envelope is very common in new and existing construction. However, steps can be taken to increase the overall efficiency of the building envelope.

Energy costs are the driving force for more energy efficient buildings. Knowledge is required to ensure that the building envelope is energy efficient, durable, and functional. There are many system components being introduced into the building envelope that must be properly used to ensure a functional building envelope.

For new buildings, proper design is required, which may include integrating the air barrier, vapor retarder, and back-up waterproofing as a single component. In existing buildings, air leakage sources must be determined and addressed. This requires hands-on investigation and knowledge of building components and materials.

Implementation of energy efficient building systems increase the overall cost of construction, but there is a viable payback of an energy efficient building envelope.That said, the building envelope systems must be properly designed and constructed with durable materials in a reliable manner. Insulation exposed to moisture, air leakage, and other inefficient construction will decrease overall efficiency. The building envelope is not a simple component, and should be considered a specialty, similar to the mechanical and electrical system. Building envelope consultants, with expansive knowledge and experience with the building envelope, should be consulted with during the design and construction of the building envelope.



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Profile: 1803 Building
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Profile: Heritage Hospital - Main Complex
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- ☐ Chicago, IL - April 22
- ☐ Bowling Green, OH - May 6
- ☐ Lansing, MI - June 3
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