

## A COMPARATIVE EVALUATION OF BASEMENT WALL INSULATION TYPES

AYŞE PEKİRİOĞLU BALKIS<sup>1</sup>

### ABSTRACT

In this study, types of insulation materials, insulation techniques for the basement and effect on environment have been studied. This paper explains the usefulness of basement wall insulation and lists the advantages and disadvantages of various insulation materials. There are many different types of insulation materials. In terms of energy efficiency, investing in high levels of insulation materials is more cost-effective than investing in expensive heating technologies. It is worth taking the time to choose the right materials in the context of whole building design. An energy efficient building envelope contains both a thermal barrier and an air barrier. The key to an effective thermal barrier is proper installation of quality insulation products. Insulation is a key component of sustainable building design. A well insulated buildings reduce costs for energy by keeping warm in the winter and cool in the summer, and this in turn cuts down carbon emissions linked to global climate change.

**Key words:** isolation, basement isolation, insulation techniques, environmental effects

### 1. INTRODUCTION

Basement insulation is a great way to conserve energy and increase the livable area in the houses. The basement presents unique challenges therefore selecting the method of basement insulation is very important. Insulation should be done on foundations to protect the main bearing construction from water and moisture effects. The main basic difference of basement foundation insulation from other insulations is the lack of opportunity to repair or correct the improperly done insulation applications. Therefore, it should be planned very precisely and applied carefully. There are three main reasons for the basement insulations which are due to soil water, pressurized water and non-pressurized water. The area that the structure rests on and side surfaces under the ground should be completely insulated. One coat

---

<sup>1</sup> Asst. Prof. Dr., Cyprus International University, Civil Engineering Departement, LEFKOŞA

of 3-4 mm thick polymeric insulation can be applied on the main shear walls against ground humidity. Also, this can be supplemented by drainage systems around the building.

Basement walls are subject to moisture from a number of fronts. Moisture can condense against the interior wall, it can be drawn into the concrete from footers or it can leak through cracks and pores in the concrete. Moisture can reduce the effectiveness of insulation and can promote the formation of mold and mildew. Choosing a basement insulation material should involve keeping the realities of moisture in mind.

## 2. INSULATING BASEMENT CEILING OR BASEMENT WALL

In most cases, a basement with insulation installed in the exterior basement walls should be considered a conditioned space. Even in a house with an unconditioned basement, the basement is more connected to other living spaces than to the outside. This connection makes basement wall insulation preferable to insulating the basement ceiling. Compared to insulating the basement ceiling, insulating basement walls has the following advantages:

- Requires less insulation
- More easily achieves continuous thermal and air leakage boundaries because basement ceilings typically include electrical wiring, plumbing, and ductwork
- Requires little, if any, increase in the size of the heating and cooling equipment.

The heat loss and air leakage through the basement ceiling is similar to that through the exterior walls of the basement.

These are some other advantages of insulation on exterior basement walls:

- Minimizes thermal bridging and reducing heat loss through the foundation
- Protects the damp-proof coating from damage during backfilling
- Serves as a capillary break to moisture intrusion
- Protects the foundation from the effects of the freeze-thaw cycle in extreme climates
- Reduces the potential for condensation on surfaces in the basement
- Conserves room area, relative to installing insulation on the interior.

The disadvantages of basement wall insulation include the following:

- Costs may exceed those for insulating the basement ceiling, depending on materials and approach selected
- Installation is expensive for an existing building unless a perimeter drainage system is also being installed
- Many exterior insulation materials are susceptible to insect infestation
- Some contractors are unfamiliar with proper detailing procedures that are critical to performance

- If surrounding soil contains radon gas, the house will require a mitigation system underneath the basement floor.

Adding insulation to the interior of the foundation is often more cost effective for an existing building. Interior insulation has the following advantages and disadvantages.

Advantages:

- Interior insulation is much less expensive to install than exterior insulation for existing buildings
- Almost any insulation type can be used, giving a wider selection of materials
- The threat of insect infestation is eliminated
- The space is isolated from the colder earth more effectively than when using exterior methods

Disadvantages:

- Many insulation types require a fire-rated covering since they release toxic gases when ignited
- Interior insulation reduces usable interior space by a few inches
- It doesn't protect the damp-proof coating like the exterior insulation
- If the perimeter drainage is poor, the insulation may become saturated by moisture weeping through the foundation walls
- Superior air-sealing details and vapor diffusion retarders are important for adequate performance (U.S. 2012)

### 3. BASEMENT INSULATION MATERIALS

While choosing a basement insulation material, effect of moisture to the basement should be considered carefully.

#### 3.1. Blanket insulation

Blanket is a long a popular insulation material, fiberglass batts and rolls are still routinely used for basement insulation. Fiberglass blanket insulation is a poor choice given that moisture degrades its insulating ability quickly and that this type of insulation succumbs easily to mold. Standard fiberglass blankets and batts have a thermal resistance or R-values between R-2.9 and R-3.8 per inch of thickness. High-performance (medium-density and high-density) fiberglass blankets and batts have R-values between R-3.7 and R-4.3 per inch of thickness, (Aktaş 1997 and U.S. 2012). The maximum thermal performance or R-value of blanket and batt insulation depends heavily on proper installation. To evaluate batt installation, batt thickness can be measured and gaps between batts can be checked. Blanket (batt or roll) insulation and installation usually costs less than other types of insulation.

### **3.2. Concrete block**

There are several techniques for insulating concrete block used in foundation construction. These involve pouring expanding foam or foam beads into the cavities of the blocks during construction. This is a very effective insulating strategy for new home construction. Insulated concrete blocks can accommodate many walls in the house. Their cores are filled with insulation (except for those cells requiring structural steel reinforcing and concrete infill), which raises the average wall R-value. The better concrete masonry units reduce the area of connecting webs as much as possible. There are several ways to incorporate foam insulation-such as polystyrene, polyisocyanurate or polyiso, and polyurethane- into concrete blocks. The hollow cores of concrete blocks can be filled by pouring and/or injecting loose foam beads or liquid foam, (U.S. 2012).

### **3.3. Foam board**

Rigid foam insulating boards don't have the same moisture issues as blanket insulation. Foam boards can be expensive, however, and need to have a fire-resistant barrier installed under most building codes. They provide good thermal resistance and often add structural strength to the houses. Foam board insulation sheathing reduces heat conduction through structural elements, like wood and steel studs. The most common types of materials used in making foam board include polystyrene, polyisocyanurate or polyiso, and polyurethane, (U.S. 2012). To make beadboard, loose, unexpanded polystyrene beads containing liquid pentane are mixed with a blowing agent and poured into an enclosed container. The mixture is heated to expand the beads many times their original size. The beads are then injected into a mold. Under more heat and pressure, they expand to become foam blocks, which are shaped as needed. Their R-values range from 3.8 to 4.4 per inch (2.54 cm) of thickness.

Foam insulations should be protected against sunlight, insect and fire. Over time, the sun's ultraviolet rays can damage the insulation. Foam may be covered with a rubber or plastic membrane. Although insects don't eat foam board, they can easily tunnel through it. Insect burrows reduce the R-value and structural integrity of the insulation. A better solution for below-grade walls in need of insulation is to install the foam board over the interior of the basement walls rather than on the exterior, which is more common. Interior applications prevent ground-dwelling insects from finding the foam board at all, and they eliminate the need for the bare inspection area. Insulating interior walls, however, requires careful attention to moisture control. Foam insulation is relatively hard to ignite, but when it is ignited, it burns readily and emits a dense smoke containing many toxic gases. The combustion characteristics of foam insulation products vary with the combustion temperatures, chemical formulation, and available air. Because of these characteristics, foams used for construction require a covering as a fire barrier, (U.S. 2012).

### **3.4. Loose fill**

Loose fill insulation like cellulose or rock wool are used when basement walls are finished. While cellulose is typically treated to be mildew and fire resistant, rock wool might be a better choice for basement insulation.

### **3.5. Sprayed foam**

It is applied as an expanding liquid, sprayed foam insulation can be a good choice for existing basement. Most building codes require sprayed foam to be covered with an approved thermal barrier-typically drywall-which means sprayed foam is best used in situations where a finished basement is the ultimate goal.

Liquid foam insulation materials can be sprayed, foamed-in-place, injected, or poured. Their ability to fill even the smallest cavities gives them twice the R-value per inch than traditional batt insulation. Most foam materials can now be used with foaming agents that don't use chlorofluorocarbons (CFCs) or hydrochlorofluorocarbons (HCFCs), which are harmful to the earth's ozone layer. They may be cementitious, phenolic, polyisocyanurate and polyurethane. Liquid foam insulation can be applied using small spray containers or in larger quantities as a pressure-sprayed (foamed-in-place) product. Both types expand and harden as the mixture cures. They also conform to the shape of the cavity, filling and sealing it thoroughly. Slow-curing liquid foams are also available. These foams are designed to flow over obstructions before expanding and curing, and they are often used for empty wall cavities in existing buildings. There are also liquid foam materials that can be poured from a container. Liquid foam insulation products and installation usually cost more than traditional batt insulation. However, liquid foam insulation also forms an air barrier. This can help eliminate some of the other costs and tasks associated with weatherizing a house, such as caulking, applying housewrap and vapor barrier, and taping joints, (U.S. 2012 and Akinci 2007).

### **4. CONCLUSION**

The right insulation system can save money, reduce the amount of energy used and make houses more comfortable. The local climate has an impact on the cost-effectiveness of any insulating project. 10% of building heat loss occurs on foundations. Application of thermal insulation has positive implications on energy saving, environmental pollution and life of the building. Installation costs are usually the most expensive part of an insulation project. Costs spent for the thermal insulation covers itself for 1-2 heating seasons. Thermal insulation decreases fuel consumption used for the human comfort in winters and summers, therefore this causes significant reduction in NO<sub>x</sub> and SO<sub>x</sub> emissions to the atmosphere and provides gains in the prevention of environmental pollution. There are many different insulation materials that can be used for basement insulation. It is the most important thing to choose the best suitable insulation material and technique for your buildings. Codes should be checked before insulation application. R values and their metric equivalent, RSI values, are a way of labelling the effectiveness of insulating materials. The higher the R value or RSI value, the more resistance the material has to the movement of heat.

## REFERENCE

- Akıncı, H. 2007. Günümüzde Uygulanan ısı Yalıtım Malzemeleri, Özellikleri, Uygulama Teknikleri ve Fiyat Analizleri, Yüksek Lisans Tezi, Sakarya Üniversitesi
- Aktaş, M. 1997. Eksik Su Yalıtımının Yapılarda Yol Açtığı Sorunlar ve Yalıtım Yapılırken Dikkat Edilmesi Gereken Hususlar. Yalıtım: Isı Ses Su Yangın Yalıtım Teknolojileri Dergisi. Sayı 9, Kasım-Aralık, 34-37.
- Ekinci, C.E. 2003. Yalıtım Teknikleri. İstanbul, Atlas Yayın Dağıtım.
- Ekinci, C.E., Yıldırım, S.T. 2004. Betonarme Temel ve Bodrum Perdelerinde Su-Nem Yalıtımının Önemi, Doğu Anadolu Bölgesi Araştırmaları
- İbrahimoğlu, G. 1997. Yapılarda Temel Yalıtımı Yapılmasının Esasları. İzolasyon Dünyası Dergisi. Sayı 4, Mart-Nisan, 25-30.
- U.S. Department of Energy, <http://www.energysavers.gov/> (25/07/2012)