Technological Revolutions to Insulate Residential Construction to Raise Condition of Life and Climate

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Abstract

Kurdistan's construction projects have advanced significantly. Despite these, recent housing studies consider sustainability issues to improve people's quality of life generally. Recent laws on energy requirements for buildings have made us more aware of the need of economic value that will improve energy efficiency as it is added to a building. This effect will likely act as a lever to prompt more appropriate responses in terms of setting as well as structures, including an assessment of energy consumption, the level of comfort of the occupants, the production of harmful substances and trash, and the rationalization of water resource use. However, there is some resistance to this on the production side, especially given the talents and experience of builders and planners who frequently approach residential building by drawing on a legacy of well-established technological and morphological solutions; thus, turning commonplace the technical offer of the market and standardizing the landscape of the developing metropolis. Without considering the characteristics of the materials that make up the envelope solutions, the recent legal situation puts priority on it in terms of thermal conduction. When it comes to the topic of insulating materials the market provides many solutions for them; these solutions will vary depending on typology, archaeology, performances, likelihood of use and production system. As a result, it is required to endorse an evaluation of the general qualities of the merchandise. It is essential to prioritize the satisfaction of the comfort level of the interior of the buildings in terms of thermal and acoustic isolation's performances. Along with that, in accordance to the building's orientation and climate area, it is crucial to consider the probability of using the material in various ways. As a final point, prioritizing how much the production and the use of a material can result in consequences on the surrounding environment is needed. The potential environmental impact (PEI) profit of the material, significant from the life cycle assessment (LCA), provides input about the intake of primary energy and available resources used to make and use the material. Technical solutions and materials evaluated in accordance to these criterions not only will contribute to the improvement of the energy efficiency of the building system, but they can also be evaluated. Through evaluation, the observing of the consequences with which the use of a solution can have on the ecosystem and the environment can take place; in a way that is beyond a plain evaluation of the use of them in thermal insulation.

Introduction

In each project, the action of selection using materials is an important part of the project related to its quality and safety. In residential construction, project building insulation is an important aspect of your project. Insulation is a technique for reducing energy use that offers barrier to the movement of heat. Heat naturally moves from a warmer to a colder area. By insulating a home, one may lessen the heat excess in warm climates and the heat loss in structures during cold climates [1]. The market and the value of housing investment continue to be supported by the development of a consolidated expansion in housing demand, both in the public and private sectors. This pressure has encouraged the development of numerous housing-related projects in Kurdistan. The "sustainable" movement in particular has significantly accelerated housing research in all areas of the building organism engaged in energy consumption control, lowering human effect and urban weight of installations on the environment, and raising occupant comfort levels. Although adding insulation during construction is most effective, doing so is theoretically possible for virtually all structures. Since there is usually potential for improvement in terms of insulation, there is often a suitable choice accessible for practically any structure thanks to the variety of insulation methods [1]. A basic need for affordable housing is no longer the focus on current market demand; instead, it is a more complex need that refers to an "additional requirement" that is unmet by current building structures because they are no longer able to satisfy a picture of needs that has fundamentally changed. In order to significantly improve both the quality of life for the residents and the environmental impact of the entire production supply chain, it is important to research the development of technical construction solutions for housing that don't call for a radical shift in the knowledge of those involved in the process. In an effort to achieve proper solutions that are able to ensure growing levels of thermal comfort within buildings, the current legislative situation establishes minimum values in terms of thermal conduction that describe the energy performance of the building. A tendency to design increasingly isolated envelopes, capable of preventing the movement of heat as much as possible, has developed from this approach, which links the choice of technical solutions and the materials used exclusively to thermal isolation, neglecting other strategic parameters for the environmental quality of internal and urban environments, especially in the summer and in hot regions.

Beyond meeting legal criteria, building materials on the market in actuality exhibit a variety of qualities depending on the product type. Others may involve unknowns, such as those relating to the life cycle of the product and the potential that they may have a harmful influence on the environment. Some of these are capable of having positive impacts, such as the possibility of assuring good levels of acoustic isolation. When it comes to their creation, usage, and disposal, synthetic materials with significant thickness, like polystyrene and other petrochemical industry derivatives, might cause issues. Globally, the effects of producing some petrol derivatives may even outweigh any future advantages resulting from their use.

Motivation

The goal of this study is to provide a clear answer to the question of what would be the best way to use technological revolutions to insulate residential construction in order to improve quality of life and climate while adhering to sustainable construction principles, or provide the truth on the effectiveness of the matter at hand.

Problem Statement

Sustainability and nobility considerations are considered in recent housing studies to enhance peoples' quality of lives generally. Recent laws on energy requirements for buildings have made us more aware of the economic value that improved energy efficiency can add to a building. Our purpose in this study is to present one of the factors that has a big impact on the building industry's ability to increase energy efficiency.

Objectives

The main objective of this paper is to optimize the passive design of newly-built residential buildings in the hot summer and cold winter region of Kurdistan to improve indoor thermal comfort while reducing building energy demand. For this purpose, researching the development of technical construction solutions for housing that don't require a revolutionary shift in the knowledge of those involved in the process is needed to significantly improve the quality of life for the residents and the environmental impact of the entire production supply chain discussed. For this ambition, we need to understand:

1- The contribution of the building envelope to energy efficiency in the building system

2- Selection of insulating materials based on multi-criteria analysis.

3- Discuss the four levels of assessments to guide an option to choose to arrive at technological solutions consistent with sustainable building principles.

How to avoid the contradiction of promoting energy conservation within a construction?

To avoid the contradiction of promoting energy conservation within a structure while utilizing high-impact and polluting materials it is important to utilize criteria that can direct the selection of materials, especially for isolating materials, concerning:

1- Comfort-efficiency conditions are assessed based on how well they improve internal building comfort (acoustic and thermal isolation); through analytical-quantitative assessment using readings for volume mass and thermal conduction values.

2- A system of preferentially-compatible use based on seasonal and weather changes. A multi-criteria analysis linked to the mass volume, values help to slow down the transfer of heat through a wall improving the interior comfort of the building in the summer. This parameter has the basic significance in summer management optimization, and minimizing or even eliminating the need for air conditioning equipment.

3- Environmental impact - an assessment of the effects of the manufacture, more precisely the consequences, and disposal of a specific product on the environment. The amount of energy needed to produce a building product is examined using a multi-criteria approach,

starting with a life cycle assessment and considering the product's potential environmental impact value, which represents a partial assessment of the product's life cycle based on the sum of its production costs, transportation costs, and on-site positioning.
This kind of material and solution research can result in creation of a technical building solution that are both economically and managerially sustainable for low- or controlled-cost projects, as well as innovative and clever in terms of technology and morphology.

Life cycle assessment

The term "Life Cycle Assessment" (LCA) refers to a tool that informs building experts about energy consumption and numerous other environmental effects that are connected to a building's complete life cycle phase [2].

Figure 1 Life Cycle Assessment [2]

What are the requirements of a Life Cycle Assessment?

A life cycle assessment demands an examination and research of the processes involved in a product's development, usage, and eventual disposal. In this process, the analysis of the

movement of materials, their packaging, and their eventual disposal, as well as the embodied energy needed to build, are included [2].

Potential environmental impact

Potential environmental consequences are the estimated effects or pressure on the environment, that could arise from using technology under specific testing or use conditions, either directly or indirectly [3].

The contribution of the building envelope to energy efficiency in the building system

Insulation has a big impact on the building industry's ability to increase energy efficiency. The first studies on the insulation of buildings are from North Europe, and they represent the need to protect structures and the internally developed activities from the cold that is typical of those climate zones [4]. The propensity to create envelopes that are **frequently** insulating and able to resist the passage of heat has developed from this approach, which links the selection of technical solutions and the materials employed simply to the value of thermal conductivity.

The proper operation of a building's "border" element, which governs the interaction between the interior and external, is a crucial aid in managing heating efficiency and achieving comfort levels in the space it encloses. The achievement of these comfort levels is necessary for the capability of ensuring perfect working conditions inside a facility, and therefore the wellbeing of all users therein. So, the building's envelope defines, contains, and protects the activities that happen within. The envelope's protective function, which is made clear, gives the structure the ability to function and fulfill the purpose for which it was designed and constructed. The element that makes the connection feasible must be planned intelligently when connecting two adjacent environments that respond to highly different logics and control systems, such as the exterior and interior of a building. This process of learning, specifies the boundaries that define and create the building's framework. Planning

a framework also entails considering how much the technological planning of an envelope element might affect the external environment of the envelope at a morphological and perceptual level; in addition to the users who can perform their indoor activities thanks to the comfort levels guaranteed by the framework's characteristics. To properly plan the building envelope: specify the potential for defining and recognizing the features of the interior environment, implement measures to provide adequate levels of thermal, acoustic, and visual comfort, and last but not least maybe increase the building system's energy efficiency.

Selection of insulating materials based on multi-criteria analysis.

Due to advancements made in the chemical industry and materials technology over the past few years, several studies about insulating materials were developed concurrently with the growth of the "sustainability"-related themes. These studies sought to improve the performance levels of the market's solutions while also exploring the potential for using materials that are not typically used in the building industry (derived, for example, from the industrial sector) to get the performance levels required by the regulation. There are two distinct ways of thinking about this subject. On one hand, proponents of biocompatible and all-natural materials advocate for solutions that consider components that come from the animal, plant, or mineral kingdoms. On the other hand, we can consider the wholly artificial solutions created by the chemical sector to improve performance and build cutting-edge technical solutions.

These two schools of thought appear to be at odds with one another; either we refer to the constructive systems and traditional techniques, with the resulting absence of formal innovation, or we entrust to the chemical industry's hard technology, whose level of development has not allowed the achievement of a good cost-benefit analysis. We are unable to employ these solutions on a broad scale since using them (such as nanotechnologies, the construction of artificial thermal inertia, etc.) to improve performance involves some sophisticated industrial production processes that offer only marginal economic convenience. A comprehensive assessment of the predisposing factors that might guide the selection of the insulating materials will help avoid the paradox of promoting the containment of energetic consumption inside buildings while using technologies that are

highly impactful and polluting. The proposed analysis focuses on developing criteria for the assessment and selection of insulating materials. It is required to evaluate the general qualities of the items within the scope of market solutions that vary in typology, performance, usability, and method of manufacture.

Beyond meeting legal criteria, building materials on the market exhibit a variety of qualities depending on the product type. Others may have issues, such as those relating to the product's life cycle and the potential that they may have a harmful influence on the environment. Some of these are capable of having positive impacts, such as the potential for assuring good levels of acoustic isolation. Some synthetic materials, such as polystyrenes and other petrochemical industry derivatives, might cause issues related to their creation, usage, and disposal. Globally, the effects of producing some petrol derivatives may even outweigh any future advantages resulting from their use. To satisfy planners, builders, buyers, and end users of the good, one solution to the problem is to establish some parameters for the selection of insulating materials, paying attention to performance levels, use possibilities, costs, and all other evaluation parameters that can address an informed choice and case of chance. Such criteria may be "grate" in the sense that they enable the optimal decision to be made in light of the circumstances.

One part of a complicated research session involves the requirement to establish specific criteria for evaluating insulating materials. Higher insulation material endurance enables less maintenance procedures to be carried out, resulting in less performance degradation over time [5]. Four selection levels were established by the proposed analysis to satisfy the need for strong physical-technical performance while also ensuring a minimal impact on the environment. The material's thermal conductivity, volume, mass, and prospective environmental effect value were considered when making the decision, which also provides a partial assessment of the product's life cycle. That is another characteristic for comparison; it is usually desirable to select a material that can create low energy consumption during production phases because of the minimal total impact on the environment.

In terms of level selection:

- First stage of selection: is thermal and acoustic performance.

The qualities of energy efficiency and comfortable living in modern buildings are greatly influenced by the acoustic and thermal insulation performances [6]. Materials that can ensure effective thermal and acoustic isolation are the subject of the evaluation. Analytical-quantitative evaluation based on readings of thermal conduction values and volume mass; comfort-efficiency conditions are assessed based on their usage in enhancing internal comfort in the building (acoustic and thermal isolation). It relates the best sound-insulating power of the materials to their excellent thermal behavior when you/they have a high volumetric mass value. The attenuation of noise, expressed in decibels, increases as there is more intermediary mass between the noise source and the environment that has to be protected. Greater levels of interior comfort are correlated with materials that have strong sound isolation capabilities.

- Second stage of selection: a system of preferential-compatible use based on climatic and seasonal variations.

In the summer, after walking or cycling to work, people frequently arrive at their place of employment feeling uncomfortable heated and perspiring. This is due to the fact that it takes a long time for body heat that was stored throughout the drive to evaporate. Operators may reduce the thermostat setpoint in response to complaints from users about this painful transition, resulting in long-term overcooling and energy waste [7]. A multi-criteria analysis linked to the mass volume value helps to slow down the transfer of heat through a wall, improving the interior comfort of the building in the summer. This parameter has basic significance in summer management optimization, minimizing or even eliminating the need for air conditioning equipment.

The volume of the material is considered at this second stage. The thermal inertia or mass effect stabilizes the temperature and ensures a lower interior temperature throughout the day by using the physical properties of the materials to lengthen the time (thermal lag) it takes for the heat wave to cross the walls. The thermal inertia of a building is the capacity of a building with a large amount of thermal mass to time-shift and level out heat flow irregularities [8]. Large mass materials provide higher noise-reduction capabilities in addition to good thermal properties. When a mass is placed between the source of the noise and the environment that has to be protected, the attenuation of the noise, expressed in decibels, increases. An adequate amount of acoustic isolation material improves the interior comfort and quality of life in the area.

The information about volume mass is also linked to the preferred use regime. This relates to the performance variations presented in either the summer or the winter. Due to environmental factors in the south of Iraq, which are characterized by mild winters and hot summers, the city of Basra presents a greater need to defend themselves from high temperatures in summer, while in other cities in Kurdistan, present a greater need to defend themselves from low temperatures in winter. The need to minimize the use of artificial air conditioners during the summer or winter season would not be realized if the advances in the use of technology in the field of building materials and construction were not taken into our accounts to create favorable interior conditions for comfort. According to that building insulation has a big impact on the building industry's ability to increase energy efficiency.

- Third stage of selection: environmental impact.

It is essential to assess the effects of the manufacture and disposal of a certain product on its production and use. Choosing sustainable materials is a crucial technique in building design. Assessment based on sustainability principles and the process of prioritizing and assigning weights to pertinent assessment criteria is two important problems that are not adequately addressed by current techniques for selecting construction materials [9]. The amount of energy needed to produce a building product is examined using a multi-criteria approach, starting with a life cycle assessment and considering the product's potential environmental impact value, which represents a partial assessment of the product's life cycle

based on the sum of its production costs, transportation costs, and positioning on-site. The approach presented here is based on a complex system of criteria that allows for performing an in-depth evaluation of the various design alternatives. Improvements in the design of energy-efficient homes lead to an increase in the environmental impact in the construction and demolition phases, creating a need to investigate the use of construction materials more carefully [10].

- Fourth selection level: costs

Given that energy scarcities and environmental pollution are two pressing worldwide issues, the efficient use of solid waste in building insulation materials is crucial for the development of the world's economy and society [11]. We can add a fourth grade to these three categories, which deals with the economics and the parametric cost of each insulating material. This last parameter is important for the overall goals of evaluating the technical solution to use, considering the intended use of the building that will be constructed.

The four levels of evaluation provide some guidance that gives the option to choose to arrive at technological solutions that comply with the principles of sustainable construction, but they do not provide a clear response to the question of what would be the greatest solution.

Conclusion

Today, it is desirable to modify the construction business, especially in terms of energy consumption and improving quality of life and the environment, based on the success in building materials through technological advancements. Based on our study, the four levels of evaluation discussed to provide some guidance that gives the option to choose to arrive at technological solutions that comply with the principles of sustainable construction. The four levels of evaluation do not answer definitively the question of what would be the best solution; therefore, this field needs more research to adapt its construction to the

developments and changes in the environment. Nonetheless, there is a definite understanding of how important it is to make modification in the construction of buildings, especially in terms of isolating them.

Citation

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