THE IMPACT OF THE DESIGNING CHARACTERISTICS OF FINISHING MATERIALS ON RATIONALIZATION OF ENERGY CONSUMPTION

- RESIDENTIAL BUILDING AS A CASE STUDY-

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ABSTRACT

The construction sector, witness a tremendous development in the field of materials used in the construction. The major flaws in most of our buildings is poor behavior and thermal disposal due the nature of Iraq's climate, which is characterized by a warm atmosphere in summer and cold in winter, which requires the use of air conditioners to provide a degree of appropriate heat inside the building, which is one of the most commonly used devices especially in the summer and thus increasing the power consumption used to operate it. In this research will be study one of the designing characteristics of finishing materials of building which is thermal insulation where the thermal insulation is the major engineering problems that need further study in the field of housing and construction problem. Where, thermal insulation is the first weapon to reduce energy consumption and its cost. For the importance of rationalization energy consumption in reducing the burden on the citizen, the goal of research will be: (Determine the effect of one of the design characteristics of the finishing materials of elevations which is thermal insulation in the rationalization of energy consumption in residential buildings). Research Method Construction the theoretical framework of the research topic, then make a comparative analysis of the model residential buildings using the design characteristics of the finishing materials of elevations which is thermal insulation, leading up to its role in energy rationalization, and access to the results and recommendations for research. Results & Conclusion Thermal insulation leads to reduce the number of air conditioners used in residential buildings and the number of uses hours, thus reducing the amount of electrical energy consumed in residential buildings at high rates ranging between 30-40% if applied on a scientific basis and technical. The rationalization of using electric power, lead to reduce the cuts of power and provide the necessary investment to establishment new stations and reduce the levels and rate of pollution resulting from the burning of fuels in power stations.

KEY WORDS: *Thermal insulation, Building, Reationalization, Consumption.*

I. INTRODUCTION

Direction of the energy in the cosmic order tends toward loss and replaced gradually, by reference to the architecture, it will force the building to be a reaction of human doing against the external environment forces to provide indoor environment archived thermal comfort and with minimal waste of energy. The residential occupies commercial and government buildings sector, the first rank in terms of electricity power consumption. Many of the designers resorted in modern times after the occurrence of air conditioners to total reliance on artificial devices to achieve climate appropriate inside the building and get the proper temperature, and which has become a burden on the user as a result of the high cost price and the cost of sustaining and then its impact on the national economy because of the need to increase energy sources such as electricity energy.

Human has developed solution for surrounding environmental conditions through long and continuous experience in the practice of construction and he was able to recognize the characteristics of construction materials then he became used most effectively to meet the needs and requirements, and one of these properties is the thermal insulation, which emerged importance intensively with the emergence of the energy crisis in the seventies calendar as a result of acceleration in oil prices and the resort of industrialized consuming nations in particular to the search for alternatives and means to reduce and rationalize consumption. In this paper, section 2 discuses, The method of the rationalization of energy consumption. Section 3 discuses, Thermal insulation as one of design characteristics of finishing materials. Section 4 discuses, The impact of thermal insulation on rationalization of energy consumption. Section 5 discuses, Residential building using thermal insulation as a way to rationalization energy consumption. Section 6 discusses, Results and discussion. Section 7 discusses, Conclusions.

The Aim of Research:

Determine the impact of one of the design characteristics of the finishing materials of elevations which is thermal insulation in the rationalization of energy consumption in residential buildings.

II. THE METHOD OF THE RATIONALIZATION OF ENERGY CONSUMPTION

The member states in Europe dealt with the legal regulations about energy consumption, from 1990 in order to reduce carbon dioxide emissions [1]. In general the rationalization is moderate and rational use of electricity away from extravagance and waste, or optimize the use of available resources and electric power necessary for the operation of the business without compromising the comfort of their users or their productivity or prejudice efficiently appliances and equipment used in or produced [2]. And the rationalization of electricity consumption reduces electricity from the list of wages. The more developed countries are the most rational use of electricity [2]. And contribute to the rationalization of electricity consumption in reducing environmental pollution and in providing electricity for all [3]. The rationalization of electricity consumption phenomenon of civilization and good behaviour required of all family members [2]. The building's energy consumption starts since the design and construction stages and needs of the building after it is created to a constant level of energy to run it [3]. It must be consistent rationalization of energy consumption with the human and his personal behavior requirements as reduce energy does not mean reducing comfort where Fisher says: that reduce energy must be seen as a first step toward restoring overlap and contact between people and environment and culture to give a real sense of place and give sprightly effective internal environments [3]. The power consumption are done by running the machines, heating, cooling, lighting, and energy consumed for the maintenance of the work environment, which represents secondary energy consumption in manufacturing processes, and energy consumed in the transport of raw and manufactured materials especially if the transport is from country to another, So it prefer to use locally manufactured materials to reduce transport energy [3]. It is necessary to focus on the rationalization of energy consumption before the creation of the building and through its establishment and after any construction that means, during the lifetime of the building. The most important methods of rationalization of energy consumption are:

2.1. Choice of Construction Materials

By choosing a construction materials with a few potential energy, which reduces the impact of buildings on the environment where the potential energy in the building materials give a measure of energy which will enter in the life cycle of the building[3].

2.2. Take Advantage of Available Resources

By Taking into account the benefit of existing resources in the building site, such as the use of solar heating and shading with deciduous trees or the signing of the building near the water source, or recycling and reuse materials, and depend on renewable energy sources, choosing local building materials which have high durability, which in turn affects the age of the building and the ratio of consumption for energy will be less [3].

2.3. Ineffective Cooling and Heating

Reliance on ineffective cooling and heating through the exploitation of solar radiation falling on the roof of the building where the building provides heat and light and ultraviolet rays and reduce heat gain in summer by shading plants and climbers and the exploitation of wind energy by cooling [3].

2.4. Shape of Building

The large size of the building means increase the surface area exposed to heat gain and loss therefore the building must be designed properly, which reduces the efficiency of heat transfer in buildings [3].

2.5. Thermal Insulation

Thermal energy transferred as a result of the difference in temperature and does not have any way to prevent transmission completely but it can reduce the transmission or impede their transition through the using of insulation material [3].

2.6. Natural Lighting

Where the sun, is the main source of light on the ground which provide better illumination of synthetic and works to reduce energy consumption and costs resulting from them [3].

2.7. Natural Ventilation

Ventilation control represents one of the most important aspects of the design, which gives a great benefit for the climate inside buildings in a lot of times where the good ventilation improve health conditions and mitigation of loads on air conditioners, especially in the mild climate [3].

2.8. Using Effective Appliances and Equipment for Power

By choosing lighting, heating, cooling, and ventilation systems with high efficiency despite the fact that prices of services be more than the device with low efficiency, but at least this will be offset by future management of these devices and the energy reduction. The use of mechanical air cooling in buildings could cause doubling of electricity consumption [3].

2.9. Planting roofs of building

The roofs of buildings receives a large amount of solar radiation which falling on the buildings, causing high temperatures in the upper floors, especially in lack of provide a good thermal insulation for the roof so it can be protected through the planting and coordinated in the form of a garden, which reduces the thermal loads on air conditioners and thus reduce the cost of energy consumption [3].

III. THERMAL INSULATION AS ONE OF DESIGN CHARACTERISTICS OF FINISHING MATERIALS

Thermal insulation conceder as the first weapons to reduce energy to the biggest consumers, namely: cooling and heating [3]. Thermal insulation is the process to prevent heat transfer from one place to another in whole or in part by taking advantage of the characteristics of some materials such as bad thermal conductivity and increase heat capacity and property of reflection [7]. thermal insulation is a substance or a combination of a range of materials which, when used properly prevent or reduce of heat transfer, Figure1, through the material by means of physically moving connectivity, convection, radiation from surrounding to another, and For buildings from inside the building to outside [4] , to find out the efficiency of thermal insulation we must know the value of Thermal Transmittance, U-value which is expresses the average time for the passage of the thermal power in watt, through structural elements inside and outside the building [5]. The unit of measurement is w/ m2.c° and when the value of heat transfer coefficient reduce, the thermal insulation capacity increase [5]. Its value depends on several factors such as properties of the material or materials that make up the elements, the thickness, the degree of exposure the external surfaces of the weather, and the increase in the value of the overall heat transfer for the construction elements increases the amount of heat lost in winter and acquired in summer and lead to increase in required for the heating and air conditioning construction energy consumption [5].

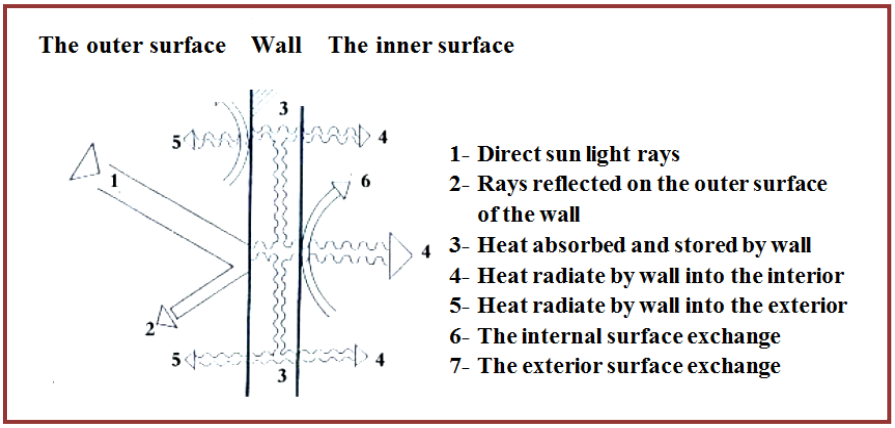

Figure1: Heat transfer through the wall [7].

3.1. Forms of Thermals Insulation

There are several forms of insulation materials are as follows:

3.1.1. Insulating Materials in Bulk

They are usually in the form of granules or powder flowing normally between walls or in any closed space can also be mixed with some other material, and it is used in particular to fill in the irregular blanks such as perlite and fermokyolite [7].

3.1.2. Insulating Materials in Flexible Format

They are differ in the degree of flexibility and usability of bending or pressure, and it is usually found in the form of cutting or rolls and prove by nails such as glass and rock wool and aluminum foil [7].

3.1.3. Solids Materials

There is in the form of plates with limited dimensions and thicknesses, such as polyurethane and polystyrene and polyethylene [7].

3.1.4. Liquid Insulating Materials

Pour or spray in or on the desired location to form an insulating layer such as foam polyurethane [7].

3.2. Types of Thermal Insulating Materials

Thermal insulation materials can be divided according to cellular installation as follows, table1:

3.2.1. Flake Insulator Materials

Materials composed of small parts in the form of flakes or scales accumulated punctuated the air such as Alvirmikiolaat and extended mica, [5] table 1.

3.2.2. Fiber Insulator Materials

Materials are composed of fibers, punctuated the air and can be made from inorganic materials such as fiber glass, Fiber Alacepctoseh, rock wool, Figure2, and glass wool, Figure3, or from organic materials such as natural wool and cotton, plant fiber and synthetic Fiber, [5] table1.

3.2.3. Porous Insulator Materials

Voids in these materials is in the pores of different size and method of distributing, it can divided into two kind, the first which are porous materials such as wood, natural straw, reeds, volcanic stones, expanded perlite, and light rubble concrete and the second are from porous materials in shape of plastics industry such as a sponge, [5] table1.

3.2.4. Cellular Insulators Materials

Characterized by the installation of a cellular with small spaces and uniformly distributed and can be made from inorganic materials such as foam glass and foam lightweight concrete and cellular and

lying mud or from organic materials such as extended polystyrene, Figure4 ,cork expanded polyethylene, polyurethane, Figure5 , formaldehyde, foam phenol, and rubber, [5] table1.

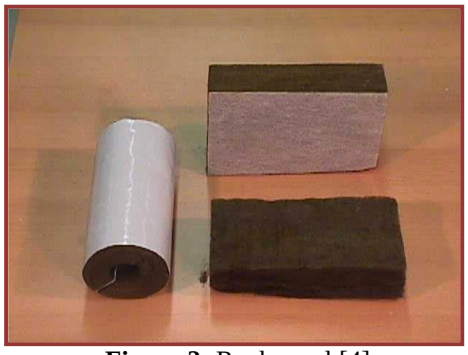

Figure 2: Rock wool [4].

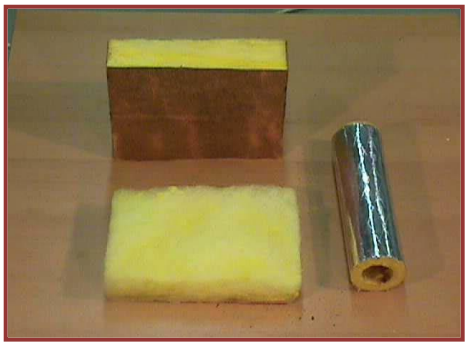

Figure 3: Glass wool [4].

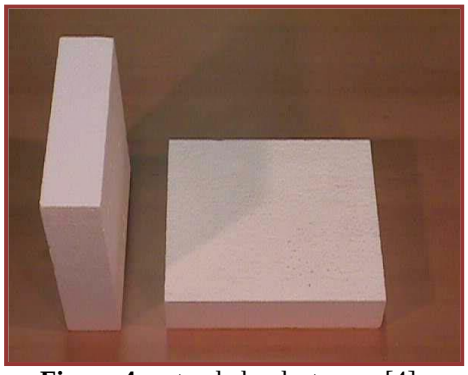

Figure 4: extended polystyrene [4].

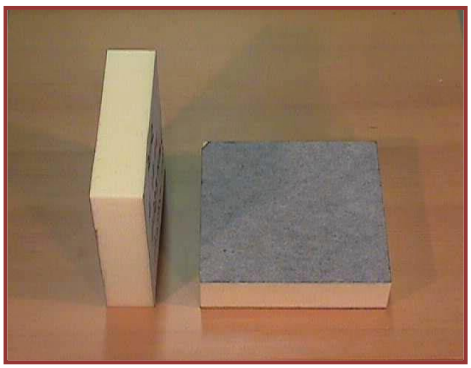

Figure 5: Polyurethane [4].

Table 1: Illustrates the types of thermal insulation materials by installed [researcher].

Types of thermal insulation material	Materials	
	Names of materials	It's kind
Cellular Insulators	Foam glass- Foam lightweight concrete Cellular concrete - Extended mud	Inorganic
	Extruded polystyrene-Cork Extender Polyethylene-Formaldehyde- Phenolic foam	Organic
Porous Insulators	Wood - Straws – Reeds Volcanic stones- Expanded perlite	Natural
	Porous Plastics such as sponge	Artificial
Fiber Insulators	Fiberglass-Fiber Alacepctoseh Rockwool-Glass wool	Inorganic
	Natural wool-Fiber plant Felt-Synthetic fiber	Organic
Flake Insulators	extended mica Vermiculite	

3.3. Location of using thermal insulation

3.3.1. Walls

Walls are part of the building which, provide protection of the building [3]. The material which used in the isolation of the walls are: glass wool or rock wool and polystyrene [9].

3.3.2. Ceilings

The use of thermal insulators in the ceilings, have a big impact in reducing the heat leakage and thus reduce the stress on air-conditioning where the isolated structure shall work as a water portfolio [9]. Therefor it is isolated ceilings thermally when the roof is the last roof, because it is the only exhibition

to direct sunlight which increases the heat of the last floor and lead to increased air-conditioning consumption rate [10].

3.3.3. Flooring

The Insulation floors by furnished a private insulating plastic materials or through the carpet [10].

3.3.4. Exterior opening

The external openings represent a main element in the design of buildings, both functionally, environmental or in determining the features of architectural form [11]. The opening is a communication between inside and outside, that allow the passage or isolate environmental effects desirable and undesirable, addition to allowing exterior vision while preserving privacy [11]. And the multiplicity of elements prevented or allowed its influence and interference types sometimes, the design of windows become a complicated process, income in several disciplines designed to achieve savings in energy consumption of acceptable economic cost [11]. The window must be able to change the permeability is an optional depending on the time and climatic conditions [11]. The choice of glass type is a main part in the window design process and should reduce heat passage from the outside to the inside in summer and increase passage to inside in winter and reduce the passage to outside in winter with increasing the amount of natural lighting and prevent dazzling with allowed to see the outside and achieve privacy [11].

3.4. Building Insulation Ways

3.4.1. Ways of Isolate New Building, Under Construction

This is done by insulating walls, floors and ceilings, as has been previously mentioned in previous paragraph (3.3.).

3.4.2. Ways of Isolate Existing Buildings

There are several ways to isolate or increase the isolation of existing buildings which are non-isolated, by insulating the walls and ceilings of the interior by installing complex panels from a slab of gypsum poster by a slab of polyurethane or polystyrene on the walls, and isolate ceilings by installing complex panel from gypsum poster by a slab of polyurethane or polystyrene on the ceilings and being mechanically fastened screws and cement or plaster glue and then paint the panels [4]. The roofs of buildings can also isolate by adding slabs of polystyrene or polyurethane over the surface and then put the tiles above it as You can use inverter tiles which is a tile + insulation [polystyrene], by putting directly above the surface, and the roof can isolate from inside by establishment, suspended ceiling and, leaving a vacuum between two ceiling [10].

3.5. Methods of Installation of Thermal Insulation

There are several practical ways for the installation of thermal insulation:

3.5.1. Installation of Thermal Insulation to The Inside

One of the most positive aspects of this method is protected the building from external factors and damage but makes the cover of the building closer to the outside temperature, and makes greater importance to the expansion and contraction in the cover of the building. The disadvantages of that result extra thermal bridges as a result of intersections and internal openings (electric and the like) that cannot be covered by isolating material and reduces the advantage of the latent heat in a building mass specially in the winter, [12] Figure6.

3.5.2. Thermal Insulation to Out Side

Natural cooling supports convection during the summer and supports natural heating from the sun during the winter and allows to mass of the building to store solar heat and excess heat gained internally but makes it susceptible to scratching and damage because it exposed to external environmental factors, [12] Figure7.

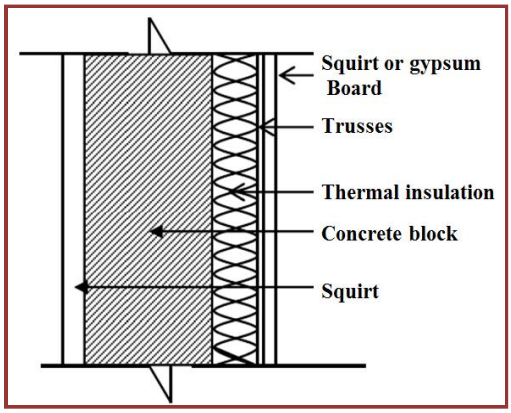

Figure 6: Installation of thermal insulation from the inside[12] .

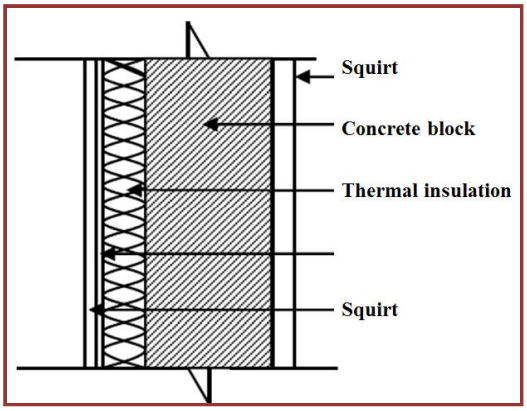

Figure 7: Installation of thermal insulation from the outside [12] .

3.5.3. Installation of Thermal Insulation in Center of Wall

Lead to the equal distribution of the insulating material in the wall of the building and achieve the balance between the pros and cons for each of the previous two methods, [12] Figure8.

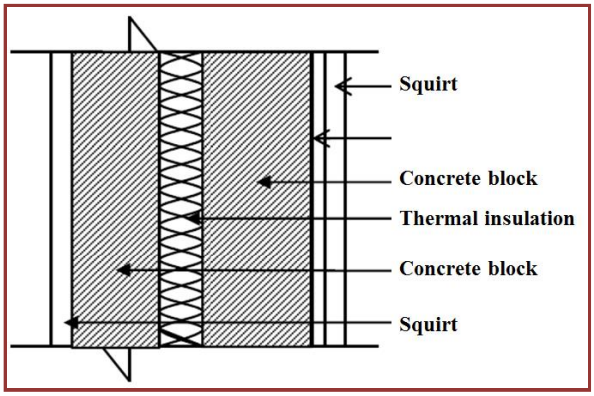

Figure 8: Installation of thermal insulation centre of the wall [12].

3.6. Criteria for Selection of Thermal Insulation Materials in Buildings

There are many kinds of thermal insulation materials in local markets and there are a number of criteria for the selection of insulating materials, which vary according to location around the world due to differences in the amount of insulation which required for a comfortable internal structure according to a climate of that location.

- It must have a resistant to bacteria, mold, fire and environmental factors that can be exposed in the place of use [13].
- It must have high resistance to thermal radiation [13].
- It must be easy to install [13].
- It must have good resistance to water absorption, vapour compression, bending, breakage, and fire [4].
- It must be economical and affordable [4].
- It must be connected with a low thermal coefficient [7].
- It should not result health damage [7].
- It has fixed dimensions in the long time and it have few susceptibility to stretch or shrink under the influence of weather and climate surrounding [7].
- It must have high degree of resistance to the stresses caused by the difference between the temperatures that lead to the expansion and contraction and the loss of some important mechanical properties of thermal insulation material [7].

- It must have good mechanical properties such as high resistance to compression coefficient and the coefficient of resistance to breakage and resistance to corrosion and deposition [7].
- We recall that all these criteria cannot meet in a one substance isolated and therefore can choose the suitable material as required to achieve the demands [4].

3.7. The Importance of Using Thermal Insulation in Buildings

Thermal insulation has a great importance and benefits of its use such as:

- Its cost does not exceed 5% of the cost of constructing the building [12].
- Achieve thermal comfort in buildings [12].
- Sound insulation [12].
- It's keep the appropriate of heat degree of building for a long time without need to operate air conditioners for a long period of time and leads to the use of air conditioning devices with small capacity and thus reducing energy costs and consumption rate of devices used [13].
- It's provided the protection and safety of the building from the weather fluctuations and changes [13].
- It's reducing thickness of walls and ceilings which required to reduce heat transfer [13].
- It's reduce the use of air conditioners, which reduces the impact of health and psychological on humans because of the noise generated by such devices [13], because the thermal comfort has a high indicator [1] .

IV. THE IMPACT OF THERMAL INSULATION ON RATIONALIZATION OF ENERGY CONSUMPTION

The problem of air cooling represents the most important factors affecting the increased consumption of electrical energy due to the increased the need for air conditioning and thus increase spending on these devices associated with consumption or maintenance, the aim of reducing the cost of buildings not only reduce the costs of personal (of the people) and improve the general economy, but also reduce the costs borne by society and the environment which is not inter in the economic accounts of the devastation and the damage suffered by the environment as a result of human activities and production processes of the Construction of the building [3]. The consumption of energy and resource Unending Once you have finished the building but the construction problems remains between the building and the environment, where the building performs it's functions, the total construction energy accounts for about 10% of the total energy consumed throughout the life of the building and that the 90% remaining are operating energy [3]. The Costs arising from the buildings as follows:

- **Direct cost [visible]:** be the result of operations restoration the building, operation and maintenance and any infrastructure needed by building [3].
- **Indirect cost [in visible]:** called environmental cost, It's two types: internal grow out of the related activities of the building occupants health and productivity, external problems arising from water and air pollution, generating waste and destruction of the environment [3].

The heat that penetrates the walls and ceilings in the summer days estimated, 60-70% of the heat which it needs to dislodge by air conditioning, and the rest comes from the windows and air vents[13]. the ratio of Electrical energy consumed which needs in the summer to cool the building at about 66% of the all consumed electricity, because of the large difference between the degrees of heat inside and outside the building, which make the users of building use the air conditioners for long periods in order to reduce the high temperatures inside the building, from here the importance of thermal insulation to reduce the consumption of electric power used in the air-conditioning purposes to reduce heat leakage through walls and ceilings to achieve a functional goal for housing and reduce the cost[13]. Where, the use of thermal insulation materials in buildings is one of the most important techniques of reduction of electricity consumption. Thermal insulation helps reduce heat in summer and reducing the cooling load and increasing the temperature which enter inside in winter, which

works to reduce heating loads and the good distribution of windows and prevent dazzling helps to reduce support with artificial lighting. Increase the amount of natural lighting works to reduce heating loads and helps to increase the average period which do not require heating or cooling, which provides a great save on cost. Accordingly, thermal insulation is important in achieving safe, healthy, convenient and comfortable indoor environmental conditions and reduction the negative environmental impact on the external environment and thus, reduce energy consumption [7]. The amount of savings of energy needed by the use of thermal insulation is between 25% -75% and depending on the type of materials used in the construction and the thickness of the thermal insulation[8]. If we compare between isolated and non-isolated buildings, we find that, Table 2.

Table 2: The different between isolated and non-isolated buildings [8].

Isolated building	Non-Isolated building
Super fact warm	It needs along time to warm in winter
cools quickly	It needs along time to cold in summer
It needs conditioner devices with less capacity	It needs conditioner devices with larg capacity
Saving reaches 40-50%	High fuel costs for heating
Less cost for conditining devices	Larg cost for conditioning devices
Moderate in summer and warm in winter	Hot in summer and cold in winter

Thermal insulation works to reduce capacity and the ability of air conditioners used for the building, which is determined air conditioners capacity on the size and air temperature which cooled required, so the use of thermal insulation, which reduces the leakage that heat leads to the need of devices with less capacities and capabilities and where that price of air conditioning rise as high capacity, the use of thermal insulation thereby reducing the cost of the purchase of HVAC and lead to energy conservation [13]. The reduction of heat leakage into the building by using thermal insulation, makes relatively acceptable temperature inside the building, even without conditioning and results in reducing the value of the energy losses in the electrical grid and reduce the pressure on the generating units, transmission, and distribution networks. In the case of isolation of the walls and ceiling of the building means to prolong the age of the building and its resistance where thermal insulation leads to secure the living comfort in both summer and winter, and helps to eliminate moisture problems and mold, and protect building materials from temperature fluctuations and thus prolonging life and isolated sounds, outside noise, and mitigation of pollution of the environment as it leads to reduce the demand for electric power and thus reduce the proportion of the gases emitted by power station into the atmosphere [8].The advantage of the climatic conditions and the use of thermal insulation materials are working to reduce the air conditioning bill (cooling and heating) at home by between 40-60% [8]. To find out the benefit of the use of thermal insulation and a comparison between the savings arising from the use of isolation in a unit area of 25 square meters, high 3 meters with another without the use of thermal insulation [4] table 3.

Table 3: The saving in consumption energy and the Maximum capacity of conditioner [4]

	Kw.h	Saving%	Max. conditioner capacity Kw	Saving%
Non-Isolated Room	10545	0	3.3	-
Isolated room	6522	38	1.9	42

And that the cost of thermal insulation materials for the new buildings represent only 5% of the total cost and by using the thermal insulation in the walls thickness of 4-6 cm and 6-7 cm thickness of the ceiling leads to savings in energy consumed per year in air conditioning about 40% [4].

V. RESIDENTIAL BUILDING USING THERMAL INSULATION AS A WAY TO RATIONALIZATION ENERGY CONSUMPTION /AVRO CITY IN DOHUK

5.1. Avro City in Duhok

Avro city in located in the north of Iraq in Dohuk, consisting of 3912 unit building on an area of one million square meters which is a residential project and a huge center of advanced life is located near the University of Dohuk on the road of Dohuk-Zakho, composed of residential buildings four models of varying sizes and villas and service centers [14], Figure9.

Figure 9: Avro City [Researcher].

5.2. Thermal Insulation Used in Construction

The energy lost through the building cover up to 10-25% of the total energy consumed by depending on the external environment and building materials, and good thermal insulation reduces heat loss in winter and heat gains rate in the summer. And insulators have been placed as follows Table 4.

5.2.1. Exterior Walls

The outer wall of all buildings and villas surrounded by thermal insulation where the panels of construction consists of a tunnel cast, and then adhesive then stick the thermal isolation panels EPS, resistant to shocks and with concrete base followed by soft net insulating then stick for the thermal insulation panel resistant for shocks and with a concrete base and finally a plastic paint against moisture [15], Figure10, Figure11.

5.2.2. Roof

Roof is from concrete and adhesive insulation then thermal isolation panels XPS then Concrete and moisture insulator then concrete [15], Figure12

Table 4: Thermal insulation using in Avro City [researcher].

Kind of isolator	Place of using	Dimension & Density	Properties
Extended Polystyrene	Walls	100*50cm 22-24	Reduce energy costs in the building to half.
			It has a high thermal insulation property.
			It has high resistance property against thermal shock.
			Low water absorption.
			Light and ease of application
			Resistant to high pressure.
Extruded Polystyrene	Roof	240*60cm 32-35	It has a high thermal insulation property.
			Excellent resistance to water
			Light and ease of application
			Resistant to high pressure.

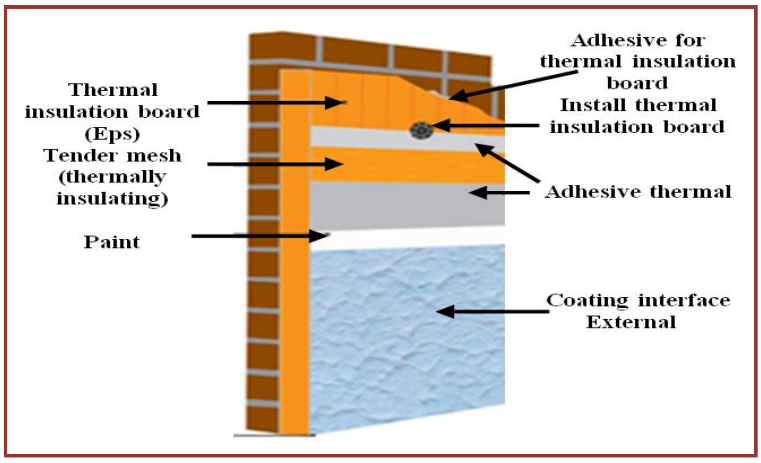

Figure10: Using thermal insulation in internal walls [15].

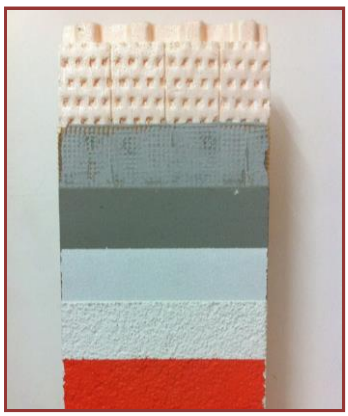

Figure11: Explain EPS [researcher].

Figure12: Explain XPS [researcher].

5.3. Practical study

The main objective of the air conditioning process: to improve room temperature and humidity temperature to be room temperature in the cooling 22 ±2 degrees and room temperature in the heating 28 ± 2 degrees and humidity 50 +5%. Currently in Iraq, popularized the use of air conditioners of the Split unit air conditioning type, where the air-conditioning device consists of two separate units, one unit installed inside the space called the indoor unit and the other outside the building and called the outdoor unit with fixed cooling process cycle not change. Air conditioners consume 70% of the value of the total electricity bill, and this type of device works on Freon, a gas found in the narrow tubes in conditioner and by the rotation of this gas cools the incoming air to come out of the other side is cold, this types of conditioner has a high electricity consumption. The average of power consumption during the one-month summer equivalent of more than 3 times the average consumption during the winter months to the same place so it will focus on the impact of thermal insulation on the use of air

conditioners in summer and optimal use of electrical devices is one of the effective means to achieve the rationalization of electricity consumption and reduce your electricity bill and the use of thermal insulation helps to reduce the electricity consumed in the proportion of air-conditioners at rates ranging between 30-40%. The fact that the thermal insulation used in buildings of Avro City, works to reduce heat leakage through walls and ceilings exposed solar rays, Figure13, which represents about 65% of the heat load of the building, thereby thermal insulation acting to reduce capacity and the ability of air conditioners, which reduces the need to use the same capacities and large capacity and which can increase the value of the cost of the bill electricity consumption at the same time reduces the duration of the device by reducing the number of hours of operation of air conditioners due to keep the rooms cool and slow loss through walls devices thus reducing the total electricity bill. The amount of energy consumed in the operation of electric vehicles in a conditioner measured by the electric computer and the unit of measurement kilo watt/ hour, and Watt, equivalent kilowatt in hour the amount of energy that consumes by electrical device 1000 watts capacity while it is running for an hour. Air conditioner with different capacity (12000-24000 thermal units) consume electricity power ranging between (2000-4000wat/h), (2-4kw/h) and equivalent consumption to 160-250 fluorescent lighting unit, the amount of energy consumed depended on the operating period and whenever it longer, the energy consumed become more and vice versa. The account of conditioner electricity consumption being by multiplying the electric capacity in kilowatt in the number of hours in which it operates and must be taken into account that the air conditioner is an electrical device operates by thermostat which stop the operation of the device when the temperature reaches the room required level. In this case the device works intermittently So, The consumption of electricity can be less than the product of the capacity in the time of work of the conditioner consumption is calculated by the following equation:

Consumption (kW / h) = power (kW) * Time in hours

A comparison between an isolated room with area 30 square meters, with altitude ceiling of 3 meters in one of the apartments in Avro City with other room is non-isolated and with the same volume and using in each of the two rooms conditioner device with capacity of 2 tons since an average of power consumption during the one-month in summer equivalent of more than 3 times the average consumption During the winter months in the same place, the account will be for the summer and considering that the number of months of summer that need to be cooled is four months.

- For Non-Isolated Room:

Suppose that the work of the air-conditioning period is 16 hours a day and the air-conditioning device including its ability 2 tons, the account shall be as follows:

Kilowatt = 1000 watts 1 cooling ton = 3.5169 kW 2 * 3.5169 = 7.03 kW

consumption = power *time = 7.03 * 16 = 112.5 kW / h

- For Isolated Room:

As a result of the use of thermal insulation, the conditioner will reached the required air conditioning degree faster than the conditioner witch used in non-isolated room, and have lost of cooler, will be slower and therefore, the period of operation of the air conditioning be less, there for its enough to operate the air conditioner for 10 hours per day.

The account shall be as follows:

Kilowatt = 1000 watts 1 cooling ton = 3.5169 kW 2 * 3.5169 = 7.03 kW

consumption = power*time = 7.03 * 10 = 70.3 kW / h

To find out the cost of the use of any device in addition to the knowledge of the expected electricity consumption at the time of using, you must know the last price of the unit consumption and the account is being by multiplied the expected use in the price of consumption unit according to the following equation: The cost of consumption = consumption (kW/h) * consumption unit

Assuming that the price of the unit consumption= 20 Iraqi dinars, the cost would be as follows:

The first case, for non-isolated room:

The cost of consumption = 112.5 * 20 = 2250 dinars a maximum consumption within 12 hours and has cost be less depending on the efficiency of the conditioner unit and the cost of consumption during the hour = 2250/12 = 187.5 dinars.

The cost of consumption during the four months shall be by the following equation:

The cost of consumption per day * number of days of the month * number of months

= 2250 * 30 * 4 = 279,000 dinars

The second case isolated room:

The cost of consumption = 70.03 * 20 = 1400 dinars a maximum consumption through 10 hours, the cost has be less depending on the efficiency of the conditioner unit and the cost of consumption during the hour = 1400/10 = 140 dinars.

The cost of consumption during the four months shall be by the following equation:

The cost of consumption per day * number of days of the month * number of months

= 1400 * 30 * 4 = 168,000 dinars

A comparison between the first and the second case, we find that using the thermal insulation consumption at least 47.5 dinars per day to 111,000 dinars during four months. Table 5 shows the amount of saving energy consumed.

Table 5: The amount of saving energy consumed savings [researcher].

	Kw.h	Saving%
Non-Isolated room	112.5	0
Isolated room	70.03	37.75

The selected room surrounded by construction on three sides with a single interface overlooking the street, which need to Thermal insulation from the outside and the area of elevation exposed to the outside is 12 m^2, considering that room high 3 meters and the length of each side actually on the external interface 4 meters and considering that isolate per square meter of the elevation cost with work wage is 42,000 dinars, to account the using insulators and number of years to recover the amount paid in isolation see table 6.

Table 6: The saving of money and energy [researcher].

The cost of using thermal insulation per m^2	The amount of saving money	The amount of saving money each year	The number of years required to recover the amount spent in isolation
42000 Dinar	42000*12= 504000 Dinar	111000 Dinar	4.5 years

It is clear from the previously that the main advantages of the use of thermal insulation in residential buildings of the Avro City are:

- Reducing the electricity consumed up to 37.75% and raise the level of comfort for users of the building with a constant temperature 25-27 degrees throughout the year.
- Reduce the capacity of air-conditioners and maintenance costs, and reduce the heat loss from the inside to outside in winter, and the heat gain from the outside to the inside in summer.

Figure13: Explain the steps of using thermal insulation [researcher].

VI. RESULTS AND DISCUSSION

Thermal insulation leads to reduce the number of air conditioners used in residential buildings and the number of uses hours, thus reducing the amount of electrical energy consumed in residential buildings. The choice of thermal insulation materials based on the scientific study of specifications and their disposal to environmental data have maximum effect to take full advantage of them in achieving better thermal gain in winter and less heat gain in summer. The aim of the thermal design is saving the energy used for heating and air conditioning and reduce heat loss, constituent cost, the cost of periodic maintenance of the devices, extensions of heating and air conditioning systems, and prolong Apartment age addition to secure conditions for thermal comfort and health conditions for occupants of the building throughout the seasons of the year. The application of the use of thermal insulation Contributes. In reduction the electrical energy consumed in air-conditioning at high rates ranging between 30-40% if applied on a scientific and technical basis where thermal insulation works to reduce heat leakage through walls and ceilings exposed to the sun, which represents about 65% of the heat load of the building to be at rest with air-conditioning, thereby reducing operating periods conditioner thus reducing consumption, and result in a longer life for air conditioning and reduce maintenance costs. The rationalization of the use of electric power leads to reduce the cuts of power and provide the necessary investment to establishment new stations and reduce the levels and rate of pollution resulting from the burning of fuels in power stations.

VII. CONCLUSION

We have needed to develop a private building rules impose the use of thermal insulators in residential buildings, where it has economic significant and environmental benefits in addition to the availability of quality internal environment for occupants. We must Taking into account the provision of information about modern structural techniques of thermal insulation to help researchers in test the effectiveness of these materials and techniques in buildings. We have taken into account the environmental aspect in terms of choosing the style of thermal insulation appropriate to the environment of Iraq, and taking into account the economic side by reducing the costs of implementation as well as the economic feasibility study taking into account future costs. We have

needed to Design models for architectural buildings suitable for the local environment and at the same time realized for rationalization programs of electric power consumption. In general, we need to apply the use of application of thermal insulation on all types of buildings without exception.

VIII. FUTURE WORK

According to these results of paper, it's important to further studies in this field by taking into consider the effect of the design characteristics of the finishing materials of elevation which is thermal insulation in the rationalization of energy consumption in other buildings such as industrial, commercial, recreational buildings and houses, and also we can making further studies by taking another design characteristics of finishing materials of elevation and study its impact in the rationalization of energy consumption.

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