Energy saving in a high insulated house in Iran

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Abstract: - High (super) insulation is a comparatively cheap method of design and construction that reduces the amount of energy needed to keep interior of a building at a comfortable temperature.
In fact, thermal insulating involves three boundaries. Insulating in respect to:

1- Human comfort that determines *sanitary* boundary.
2- The heat loss of Building components that determines *physical* boundary.
3- Insulation costs and its amortization at a suitable time that specifies the last boundary and also due to energy rate floating, *economical boundary* will float too.

In this article we consider one story house with two units, total area of 300 m² in Tehran, built by local building materials as a case study in three cases:
1- Without thermal insulation
2- Within thermal insulation
3- With high insulation
The result shows *53.4%* of third case toward second case and *78%* compared with first case on energy conservation in building.

Key-Words: - Building physics, Solar energy, High insulation, Energy saving, Economical analysis

1 Introduction

Most problems in the field of energy and environment needs urgent consideration and that can be achieved sustainability.

The criteria of thermal insulation written in 1989 were ratified to the Islamic Council Assembly in 1991. On the first month of 1382 Farvardin (March-April), with the great efforts and extended unremitting of the economy responsible related to the consumption, energy became obligatory in some of the Tehran municipal districts, big cities, provinces, in all the governmental buildings whether public building or residential buildings which are invested by the government. This is of an importance for the future due to the limited source of energy and the growth of energy consumption (usage) in the last decade and also it was the perspective of providing energy. [1]

2 Economizing Energy Consumption

Economizing in energy consumption in buildings, however, grew after the shock of 1973's in Europe. Scientists and the experienced analyzed the issue from the difference view points. They got the following results:

In order to economize the energy consumption we should use and also prevent of wasting solar radiation energy through the constructional transparent elements (windows).

The base of using of solar energy is in fact thermal insulation of a building outward cost. Since we can just now use of only ten percent of solar radiation, therefore to keep the solar energy within the building, which causes fuel to be economized, we should insulate thermally the buildings. Unfortunately, there are not any possibilities of analyzing about exact statistics of energy consumption in buildings due to giving less importance to the researches in our country. On the other hand, some existence data have not been analyzed too. So it is necessary to be familiar to the information of some European buildings although their climates are different with our country situation, and it is methods and use them correctly in the country.

Thermal insulating involves three boundaries:
1) Insulation according to human comfort which sanitary boundary determines it.
2) Insulation according to thermal wasting, a constructional element which physics boundary defines it.
3) Insulation according to values of insulation and its amortizing during the suitable time that specifies the last

boundary, and also due to the energy rate floating economical boundary will float too.

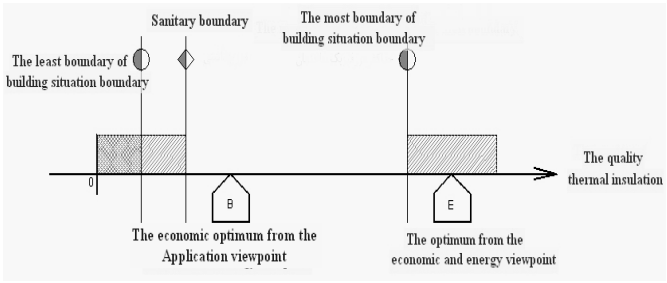

Diagram1: Optimum energy

2.1 Thermal insulation

In ordinary buildings without thermal insulation ,since the outer parts of the building have not any resistance against the energy wasting, for adjusting of buildings inside condition whether from the heating or cooling situation we have to use great energy. We can reduce this wasting of energy according to the existence programs with the thermal insulation, we know well that cost of energy consuming is increasing in the world and I our country, its better to be familiar to the ways and the developed countries technology about how they apply them and how they use high heat insulation.

Anyhow, high insulation should be considered of the economic view point. Using and applying thermal insulation about the thermal transitional factors of building elements:

- Roof: U=1.0 W/m ² K
- Exterior Wall: U=1.1 W/m ² K
- Window: U=3.0 W/m ² K
- The roof and basement walls near the uncontrolled spaces: U=1.2 W/m²K
- Times of air infiltration per hour N=0.5 h
- The heat of inside the building related to the human and his /her belongings: 125 kwh .person
- Using of energy and energy products through the suns radiation.
- The buildings which have been built before 1945 with 0.14m² windows.
- The buildings which have built after 1945 with 0.16m² windows.

2.1.1 Brief review in three cases

1- Two story buildings with two residential units and small insulation with windows from the different geographical sides with usual one layer glass.

2- The same building with two layers resistant windows against thermal conductivity which can compensate lots of thermal loss (1.8 Mwh/yr) in winter by the windows.

3- The same building with high heat insulation: An amount energy taken by the windows not only compensate the thermal loss through the windows but they include efficiency(0.75 Mwh/yr) from the suns radiation, and in fact due to the high heat insulation the efficiency from the suns radiated energy economizes about 24.5 percent of consumption of pure energy.

In each three above cases the amount suns radiatedenergy is about the same and it is equal to 2.2 till 2.3 Mwh/yr, but is a house which is determined with the supper heat insulation, causes to use economizing in energy consumption.

Now if the main windows of that building are of the southern side and its outer aspect faces towards the south:

- A building with normal thermal insulation and window with one layer glass: the suns radiated energy can compensate and prevent of thermal loss through the windows (2.1 Mwh/yr) and keeps a little amount of fuel consumption (0.46 Mwh/yr).
- A building with normal thermal insulation, and the main outer aspect none the southern side with two layer glasses, can compensate of thermal loss through the windows about 580 kwh/yr. in fuel consumption, and pure from the suns radiated energy 1.98Mwh/yr.
- A building with the high heat insulation of the suns radiated energy not only compensates the thermal loss through the windows (1.5 mwh/yr.) but it economizes a lot of energy.

According to the above cases, with the high heat insulation not only the comfort of sanitary boundary and the requisite of building physics boundary are carried out but with the economy which will be developed in long period of time, can economize in energy consumption. (Table 1)

2.1 Energy efficiency and solar radiation

Efficiency of the solar radiated energy to reduce the fuel consumption in buildings with one or two stories radiated to the thermal insulation of a building:

The information which we took about the process of European thermal European thermal insulation from the usual insulation till high insulation and from it to the heat insulation we discuss and analyze simply about the high insulation in Iran, for example, a house in Tehran located in Sadegiye district with one story of 300m² with two residential units. Its material which is used there, the roof of vault, the walls of clay bricks, the iron windows with one layer glass, and with no basement.

-This house has been calculated without thermal insulation, and its thermal square is by one mete square and one degree centigrade into time unit

-If we want to optimize the thermal insulation, the above house according to the programs of part 19 of the national rules of building, and this shows about 54 percent of economizing the fuel usage.

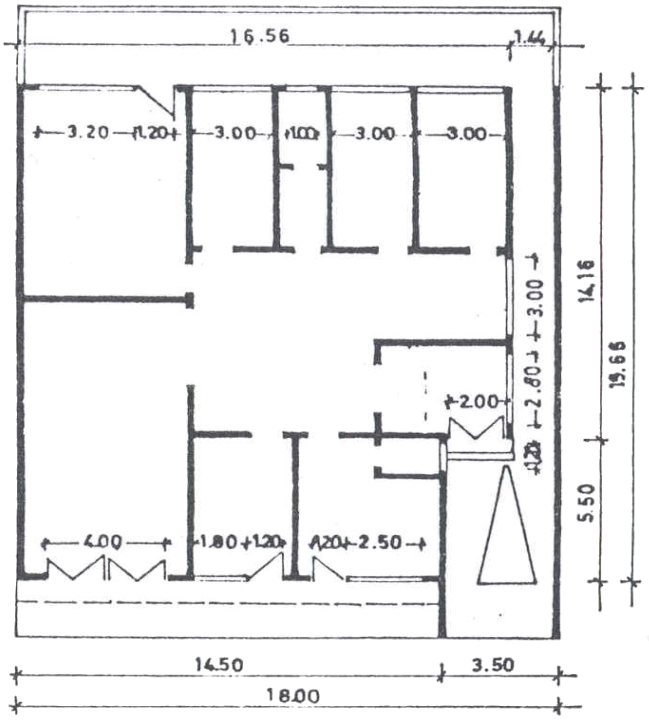

Fig.1: Plan of the house

3 High Heat insulation

Now, if we insulate this house with high heat insulation, its thermal square will be about 1.647…in every meter square with one degree centigrade, and this shows that the proportion of the thermal insulation is 53.4 percent, and the proportion of no insulation which most of our country's buildings which not only they have this situation but mostly will show great thermal square and as a result it gives about 78 percent of economizing in fuel usage.

According to the performed experiments and experiences about 40-42percent of heating energy of the building wastes through the holes of doors and windows, so in Sadeghiye's hours the structure of petro-chemical materials, and with suitable caulking and two layer glasses, and times of air circulation with high quality control of 0.75 times in an hour and for the thermal insulation of roofs, caulking of outer doors the thermal insulation is considered about 15-17 centimeter thick.

Today in the world, construction and building moves towards the light-making and dry-making. In a high (super) insulation way, due to the great thickness of thermal insulation we can dispense with the heavy outer walls, and build the outer walls with acceptable details and with the light walls ways, these ways cause kinds of structures to the construction will be short and meanwhile this will cause suitable effort in buildings resistance against earthquakes dangers. [2]

4 Conclusion

Maybe the most logical understanding and deduction of above numbers is that the best way is that instead of sampling our national capital and interest in the way of optimum insulation, that is to say, the way that 20 years ago, developed countries took it in order to prevent of wasting of capitals, we should accelerate our movement and take our aim towards the high insulation, because we are going to reduce considerably cost wasting, capital wasting, and the time of applying and time of removing our society's necessities we can prevent of wasting the sources and capitals in future, and then we can make up for the past, due to inattention to thermal insulation and continue the construction with the modern technology and create jobs for the youth of our society.

Thermal Insulation	Window Side	Thermal Efficiency MWH per year Impure	Pure	The efficiency percentage of radiated energy Impure	Pure
Typical U Opak = 1.0[w/m² . K] U transp. = 3.0	4 sides	2.3	0-0.2	10%	--
typical	south	2.5	0.5	11%	2%
Typical with double paned window	4 sides	2.3	1.8	10.5%	8.4%
Typical with double paned window	south	2.6	2.0	12%	9.3%
High U Opak = 0.3[w/m² . K] U transp. = 1.6	4 sides	2.3	0.7	24.5%	9%
Super U Opak = 0.3[w/m² . K] U Transp. = 1.6 "	south	2.6	1.0	27.7%	13.2%

Table 1

Building Element	U[W/m²K] Without insulation	U[W/m² K] optimum	U[W/m ² K] With super insulation	p[W/m² K] Without insulation	p[W/m² K] optimum	p[W/m² K] With super insulation
Final Roof	1.541	0.366	0.16	1.565	0.368	0.16
Exterior Wall	1.96	0.56	0.2	0.45	0.18	0.04
Wooden Door	2.22	---	---	0.03	0.03	0.03
Metal Doors and Windows	5.24	2.92	1.60	1.20	0.67	0.36
Surface adjacent to the Soil	1.3	0.785	0.3	1.17	0.71	0.27
transitional energy				4.415	1.958	0.86
transitional energy by the air				3.15	1.575	0.7871
thermal load				7.5651	3.533	1.647

Table 2

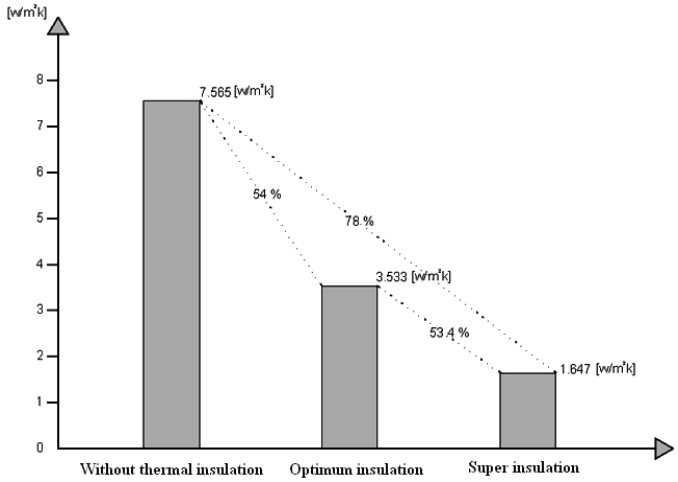

Diagram2. Energy saving percent among three cases

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