Reference

Annex 1 National building Code 19

19-1 General information

This article of national building codes determines regulations for design, calculation and implementation of thermal insulation in building envelope, heating, cooling, ventilation, air conditioning, consuming hot water supply installation systems and the obligations for designing lighting systems in buildings.

In the first chapter general information and definitions and in the second chapter general regulations for designing and construction are mentioned. The third chapter focuses on building envelope insulation methods and some recommendations about architectural design. The forth chapter is about regulations regarding mechanical installations and regulations for lighting systems and electrical installations are presented in the fifth chapter. Moreover, in complimentary information and calculation methods corresponding to different chapter are given the 11 attachments of this code.

It should be mentioned that along with the observance of these regulations minimum ventilation required for the residents health should be considered, too.

19-1-1 Scope of application

The regulations presented for building envelope (chapter 19-3) is obligatory for all types of buildings except buildings group 4 from the energy saving point of view (refer to chapter 19-2-2-5). These regulations are mentioned in the form of two methods: A (System performance method) and B (prescriptive method). The former is applicable to all buildings but the latter can only be used in 1-9 story residential buildings, with the useful floor area of 2000 square meters and building group 3 from the energy saving point of view.

The observance of the regulations related to Mechanical systems and installations (chapter 19-4) and lighting systems (chapter 19-5) is obligatory for all buildings with the types of occupancy mentioned in attachment 4 of this manual.

19-1-2 Definitions

- Construction:

The act of constructing a building on an empty land

- Thermal inertia:

The general capability of the building envelope and internal partitions in saving energy, returning energy and affecting temperature fluctuations and thermal and cooling loads in the conditioned spaces.

Building thermal inertia is categorized according using the building's useful surface mass. (Refer to attachment 1)

- Renovation:

Reconstruction of the building's main sections which have been damaged because of some events or wear out

- Opening:

All kinds of surfaces in building envelope that can be opened and are used for the achievement, supplying lighting, outside view, sending out the gas resulted from fuel combustion, ventilation, air conditioning; like all types of doors, windows and skylights

- Flat roof:

Building's final cover which has a slope equal to or less than 10 degree according to the horizon

- Pitched roof:

Building's final cover which has a slope more than 10 and less than 60 degree with respect to the horizon

On the pitched roof is the outside space and unconditioned or conditioned spaces are under it. According to this code if the slope of a partition is more than 60 degree, it is considered as a wall.

- Energy label:

The label which is determined by the qualified authorities to stick on the industrial products used in buildings in order to specify the quality of the products from energy consumption point of view.

- Thermal terminal:

A part of a cooling or heating system which is located at the end of the circuit and transfer the energy, which is transferred by the distribution circuit, to the conditioned space(s) like radiators

- Thermal bridge:

Parts of the building in which the thermal resistance reduces because the discontinuity of the building envelope's thermal insulation and it causes topical increase of heat transfer rate

- Building envelope:

All surrounding surfaces of the building including walls, ceilings, floors, openings, translucent surfaces and so on which on one hand are connected to the outside or unconditioned space and on the other hand to the conditioned spaces inside the building

Building envelope is not necessarily the same as physical envelope, because physical envelope can include unconditioned spaces, too. Building envelope also includes elements which on their external side are adjacent to soil and ground.

- Physical envelope:

All surrounding surfaces of the building including walls, ceilings, floors, openings, translucent surfaces and so on which on one hand are connected to the outside space and on the other hand to the conditioned or unconditioned spaces

- Air exchange (air change):

Supplying the healthy conditions for the air inside conditioned space with exchanging a specific amount of that with fresh air in a period of time

- Change of occupancy:

Changing the type of operation in the existing building

- Development:

Extending the area of existing building or adding to its floors

- Ventilation:

The process of blowing or sucking air, naturally or mechanically, to or from any space, in order to provide health and comfort conditions (including temperature and air moisture rate control, preventing condensation, preventing the microorganisms' growth and so on),

Such air can be conditioned.

-Air conditioning:

Kind of ventilation together with the adjustment of factors such as temperature and moisture and elimination of different pollutants (like odor, dust, microorganisms) for providing the determined conditions

- Translucent or transparent layer:

A partition or layer whose visible light transfer coefficient is more than 0.05

Translucent layer is of two types, checkmate (opaque) and transparent (hyaline) and includes widows, external translucent faces, doors, skylights and so on.

- Surface mass:

The average mass of one square meter of building or physical envelope's surface

- Effective surface mass of partitions (m_i):

The surface mass of the internal side of the building envelope partition or building's internal partitions which is considered in calculating effective mass and thermal inertia of building (refer to attachment 1)

- Effective mass of partitions:

Effective surface mass multiplied by partitions surface

- Building effective mass (M):

Total effective mass of the building envelope partitions or building's internal partitions which is considered in calculating thermal inertia of building (refer to attachment 1)

- Building effective surface mass (m_a):

The ratio of building effective mass to building usable area (refer to attachment 1)

- Wall:

Part of building's non-translucent internal or external envelope which is vertical or located with more than 60 degrees slope according to the horizon

- Cooling degree day:

A unit based on temperature and time which is used for estimating energy consumption and determining cooling load of a building in the hot seasons of the year. Cooling degree day is equal to total average temperature difference in a day according to 21 degree Celsius in times of the year in which the average daily temperature is more than 21degree Celsius

- Heating degree day:

A unit based on temperature and time which is used for estimating energy consumption and

determining heating load of a building in the cold seasons of the year. Heating degree day is equal to total average temperature difference in a day to 18 degree Celsius in times of the year on which the average daily temperature is less than 18 degree Celsius

- Building usable area (A_h):

Total floor area of the conditioned spaces in a building

- Individual (detached or semi-detached) dwelling:

A building with at least two stories which is separated from other surrounding buildings in 4 sides or has a common space of less than 15 square meters with them. In this code it is shortened to "individual building".

- Attached building:

Any building that cannot be included in the definition of the "individual detached or semi-detached dwelling" is known as attached building

- Automatic control (& cut out) system:

A system that automatically adjusts the fluid temperature or temperature of the spaces by turning heating and cooling installations on and off

- Solar index (I_s):

A coefficient upon which the amount of solar radiation energy utilized in the building is determined

- Low-E (Emissivity) glass:

A glass that has special metal-base microscopic coatings on one or both sides and consequently the infrared radiation of its warm surface to the surrounding cold surfaces and therefore its heat transfer coefficient is reduces comparing to transparent (hyaline) glasses. Transparent (hyaline) glasses usually have the emissivity coefficient of about 0.85 but the emissivity of the low-E glass, on the surface covered with low emissivity coating, can be reduced up to 0.05.

- Building heat loss (transfer) coefficient (H**):**

The heat loss (transfer) coefficient of a building, or part of it, is equal to sum of the heat transfers from the partitions of conditioned spaces if the temperature difference between inside and outside air is 1 degree Kelvin. The unit used for heat transfer coefficient is [W/K]. In the system performance method, it is compared with the "required heat transfer coefficient".

- Linear thermal transmittance (ψ):

The linear thermal transmittance of a one-dimensional part of the building envelope is equal to the thermal power transferred from one meter length of that element if the temperature difference between inside and outside air is 1 degree Kelvin. The unit used for linear thermal transmittance is [W/m.k].

- Thermal transmittance (U**):**

The thermal transmittance of a part of the building envelope is equal to the thermal power transferred from portion of its surface with the area of one square meter if the temperature difference between inside and outside air is 1 degree Kelvin. The unit used for thermal transmittance is [W/m².k].

- Required thermal transmittance (Û):

The required thermal transmittance is the thermal transmittance for all kinds of partitions forming building envelope (like wall, ceiling, floor, translucent layer, and door) which is used for calculating required heat loss (transfer) coefficient in this code. The unit of required thermal transmittance is [W/m².k].

- Required heat loss (transfer) coefficient (·):

The required heat loss (transfer) coefficient is the maximum allowed heat transfer coefficient for a building or part of it and is calculated using the equations presented in this code. The unit used for required heat transfer coefficient is [W/K].

- Surface heat transfer coefficient (h):

The ratio of surface heat flux to the temperature difference between partition surface and adjacent air in a stable status (refer to attachment 8)

- Required heat transfer correction factor (γ):

The coefficient which is calculated for correcting required heat transfer coefficient if appropriate design and optimum utilization of solar energy take place in cold regions

- Thermal transmittance reduction factor (τ):

As the temperature difference between inside and unconditioned spaces is less than the one between inside and outside spaces, a coefficient called "thermal transmittance reduction factor" is considered in calculating heat transfer from the surfaces adjacent to unconditioned spaces (refer to chapter 19-3-1-3-5).

- Solar transmittance (S):

The ratio of solar energy passed through translucent layer to the solar energy which shone to it.

- Thermal conductivity (λ):

The amount of heat passes through one square meter of a homogeneous element with the thickness of one meter, in steady state, when the temperature difference between two sides of the element is one degree Kelvin. The unit for thermal conductivity is [W/m.K].

- Thermal insulation (Insulating material):

Material or a compound system which effectively reduces heat transfer from one environment to another and in addition to that in some cases it can be used for other applications like bearing and sound insulator. The word "insulation" in this code means thermal insulation. In some specific conditions air can act as thermal insulation, too.

Thermal insulation applicable in buildings is an insulation that has thermal conductivity of less than or equal to 0.065 W/m.K and thermal resistance equal to or more than 0.5 m²K/w.

- Thermal (heat) insulation operations:

The application of thermal insulations in order to limit heat transfer rate in building components

The insulation system should have the following 2 factors:

- Thermal resistance of the whole building envelope with thermal insulation should be a little more than a specified limit.
- Thermal conductivity of the used insulation should not be more than a specified limit.

Sometimes the thermal resistance mentioned in building codes can be achieved by using suitable material in the building envelope without using thermal insulation.

If the building components are properly insulated, thermal comfort in conditioned spaces can be easily provided and maintained with energy saving.

Thermal insulation operation is done by special material or a multi-task system. For example a load-bearing wall can also act as thermal insulation, but in most cases it is necessary to add a special layer, merely as insulation, to the wall.

- Internal thermal insulation:

Thermal insulating of the building components which is done by adding a layer of insulation on the inner side

- External thermal insulation:

Thermal insulating of the building components which is done by adding a layer of insulation on the outer side

- Peripheral thermal insulation:

Thermal insulating with a limited width on the floor on soil, adjacent to and along walls of building envelope

- Distributed thermal insulation:

Type of building insulation in which the material, either structural or non-structural, used in main part of the building envelope thickness (wall, ceiling, and floor) has high thermal resistance.

- Building elements:

Parts of the building that are designed and made for supplying structural or non-structural needs and provide building's integration in connection together (like roof, ceiling, floor, wall, and opening)

- Specific factors:

The factors that specify building status, from the view point of energy saving amount. These factors are of two types, main (basic) and subsidiary (refer to chapter 19-2-2 and 19-2-3).

-Living space:

The building which people use in everyday life including residential space, working space and so on

- Conditioned space:

Parts of building internal space, including living space or other, which are warmed or cooled up to the temperature equal, more or less than the habitat temperature continuously because of their special operation

- Unconditioned space:

Parts of the building spaces which do not follow the definition of conditioned space (like the

air-tightened separating gap between two buildings, stairs, corridors and parking areas that lacks cooling and heating terminals)

- Building occupancy:

Type of building application based on the categories presented by Management and Planning Organization (refer to attachment 4)

It should be mentioned that the phrase "Possession Mode" is used instead of "occupancy" in some chapters of national building codes.

- Floor:

The horizontal building element that is adjacent to a conditioned space from above and to soil or unconditioned or outside space from below. It is considered as a part of building envelope.

- Background heating:

Building's main heating which is adjusted by outside temperature.

- Complementary heating:

Building's subsidiary heating that is designed for dealing with short-term heating needs when the background heating is not individually enough

- Composite heating:

The heating comprised of both background and complementary heating

- Low consumption (high efficiency) lamp:

A lamp with an efficiency of more than 50 Lumen/Watt

- Thermal comfort zone:

The heating and humidity conditions in which nearly 80 percent of the inhabitants or users feel comfortable

- Normal temperature interval:

The temperature interval that must be maintained in spaces that has specific operation

- Competent authorities:

The authorities whose qualifications on the fields determined in this code are formally approved like BHRC or ISIRI (Institute of Standards and Industrial Research of Iran).

- Thermal resistance:

The ratio of layer thickness to its thermal conductivity; it is formed of some layers equal to total resistance of each layer.

Thermal resistance reveals the capability of envelope or one or some layers of it to be thermally insulated. It is shown with "R" and its unit is [m^2K/W].

-Air leakag**e:**

Air coming in or going out of the building through holes and channel other than the ones specified for air exchange

- Residential unit:

A house that has one or more rooms and is supplied with full and independent facilities (for sleeping,

eating, cooking and health) for one person or more to live in

- Air tightening:

Preventing air entrance and exit trough envelope or gaps of its elements

19.2. General Regulations of Design and Construction

19.2.1. Documents needed for Obtaining Building Permit

For obtaining the building permit, issuance of following documents are necessary for approval of building in terms of energy saving.

19.2.1.1. Qualification Certificate of Designing Engineer or Company

19.2.1.2 Energy Checklist

Energy checklist must include the summary of following information:

1. Profile of building and designing engineer.
2. Main special factors:
   - Building occupancy classification (according to 19.2.2.1)
   - Classification of annual energy demand of building neighborhood (according to 19.2.2.2);
   - Building usable floor area classification (according to 19.2.2.3);
   - Classification of City in which the building is constructed (according to 19.2.2.4)
3. Building classification in terms of energy saving (determined based on main special factors mentioned and according to paragraph 19.2.2.5);
4. Classification of the way the building is used (discontinuous or continuous based on 19.2.3.2);
5. The method used for thermal insulation of building envelope.
6. Thermal specifications of materials used in structure;
7. Thermal specifications of the walls constructing the building envelope;
8. Building heat transfer coefficient (in case of using system performance method)
9. Set of technical solutions used and regulations determined considering the position of walls and their thermal insulating procedure (in case of using prescriptive method)
10. Technical specifications related to energy consumption of mechanical heating and cooling systems, air conditioning and hot water system;
11. Lighting intensity of spaces and lighting controlling system

19.2.1.3. Building Plans

Building plans include floors plans, roof plans, views and cuts, executive details of building envelope. Places of thermal insulation according to building classification in terms of amount of energy saved must be specified in floor plans, roof plans, views and cuts. (Attachment 5)

Executive details of building envelope must be prepared in scales of 1:1, 2:1, 5:1 or 10:1 (based on demands), and thermal insulation procedure and technical specifications of materials forming the building envelope must be distinguished in them.

If the building is constructed, plans related to all floors must be submitted. In case of improvement, reconstruction, change of occupancy or building expansion; only submittal of the information related to unit or independent units subject to change is enough. All the mentioned plans technical

specifications must be signed and approved by designing engineer or company.

19.2.1.4. Physical specifications of materials and thermal insulation systems

If in designing and construction of building, traditional materials and insulating systems are used, required technical specifications like density and protective shield, accompanied by plans and other documents must be submitted for determination of heat transfer coefficient and thermal resistance of used materials and insulating systems in building envelope based on instructions of authentic bodies or based on tables 7 and 8.

If specification values of certain materials or building elements are not found in competent authorities, or if the constructor claims that he has used products with better thermal specifications values than the ones set by authentic bodies, it is necessary to attach valid technical certificate of products to the documents. This certificate must include heat transfer coefficient or thermal resistance of the product considering the width used in building design and other technical specifications required for comprehensive assessment and also the executive regulation of the material.

In this case, values mentioned in technical certificate, meanwhile the certificate is valid, are considered as reference for design and calculations. Making use of products like thermal insulators or insulating doors and windows with energy labels is the first priority.

19.2.1.5. Technical specifications of Mechanical and Lighting systems

Technical specifications related to energy consumption of mechanical systems used in buildings including heating, cooling, ventilation, air conditioning and hot water systems and also lighting system must be determined by valid authorities so that they can be used in calculations and design. In case of lack of technical specification certificate, certain measures must be taken in order to determine needed technical specifications before making use of equipments.

19.2.2. Main specific Factors and Building classification

Minimum amount of required energy consumption saving which is determined for building envelopes in this section depends on four main specific factors. Based on these factors buildings are classified in terms of amount of required energy consumption saving. Main specific factors determinative in classification of building in terms of required energy consumption saving value are:

- Building occupancy classification;
- Classification of annual heating-cooling energy demand of building location
- Classification of building usable area.
- Classification of city in which the building is constructed

In this section first the classification of each of above mentioned factors and then structure classification in terms of energy consumption saving value are studied.

19.2.2.1. Classification of Building Occupancy

Buildings are classified into four groups of A, B, C, D in terms of occupancy. For determination of building classification in terms of occupancy refer to attachment 4.

If a section or some sections of building, with area of more than 150 square meters, having a different occupancy than general occupancy of building (occupancy of larger section of the building), are included in internal space of the building, separate classification must be considered and regulations related to that occupancy must be observed.

19.2.2.2. Annual Energy Consumption Classification of Building Location

In this section, various regions of the country are divided into three groups in terms of heating-cooling energy demand:

- Regions with low annual energy demand
- Regions with medium annual energy demand
- Regions with high annual energy demand

In attachment 3, classification of annual energy demand of 245 cities of the country which have weather stations have been mentioned. If the building is located in a city which is not mentioned in this attachment, data of nearest weather station must be considered as reference.

19.2.2.3. Classification of Building Usable Area

Under this topic, buildings are classified into two groups in terms of usable area:

- Buildings with usable area of less or equivalent to 1000 square meters
- Buildings with usable area of more than 1000 square meters

19.2.2.4. Classification of city in which the building is constructed

Under this topic, cities are divided into two groups:

Large cities: Province capital cities and cities with population of more than 1 million.

Small cities: Cities with population of less than one million which are not province capital cities.

19.2.2.5. Classification of Building in Terms of Energy Consumption Saving Values

For design of buildings, according to regulations of this topic, it is necessary to determine the building classification in terms of energy saving. Under this topic four groups of buildings are:

Group 1: Buildings which are required to highly save energy

Group 2: Buildings which are required to moderately save energy

Group 3: Buildings which are required to slightly save energy

Group 4: Buildings which are not required to save energy

Building classification, in terms of energy consumption saving, is determined based on table of fifth attachment after determination of main specific factors. Under this subject, by buildings 1, 2, 3 or 4 is above mentioned classification.

19.2.3. Secondary (subsidiary) Specific Factors

Minimum amount of required saving in determined energy consumption, depends on other specific factors, which are named secondary specific factors. Secondary specific factors are:

- Conditions of making use of solar energy

- How the building with none residential occupancy is used.

19.2.3.1. Classification in terms of making use of solar energy

Buildings, in terms of making use of solar energy, are classified into two groups:

- Buildings which are located in a place that can make adequate use of solar energy.
- Buildings which are located in a place which have limitations in use of solar energy.

A building is recognized as a building in a good position to make use of solar energy, which according to attachment 3, does not have dominant cooling demand and area of transparent walls in south east to south west direction is more than one ninth of structure usable area and also masses preventing the sun light must have angle less than 25 degree (refer to attachment 2)

A building which does not have the above mentioned qualifications is considered as a building which can't make adequate use of solar energy.

19.2.3.2. Classification of the way building with none residential occupancy is used

None residential buildings in terms of use are divided into two groups:

Discontinuous use: using the building (or a section of it) in a way that at least 10 hours out of 24 hours the building is not used and temperature control can be halted.

Continuous use: Using the building (or a section of it) in a way that is not subject to discontinuous use.

If some sections of building are used continuously and some others are used discontinuously, the larger section must be considered as reference unless the area of smaller section or sections are more than 150 square meters, in this case thermal calculations must be done separately.

In following cases spaces with discontinuous use are considered as continuous:

- High thermal inertia of walls (refer to attachment 1)
- When it is not possible to decrease temperature more than 7 degrees Celsius under temperature range determined for when building is used
- This classification is effective in determination of required thermal transmittance (system performance method, paragraph 19.3.1.2)

19.2.4. Methods of designing building envelope

Regulations of designing building envelope, for reduction of heat transfer, have been mentioned in 19.3. Design and determination of level of thermal insulation of elements of building envelope excluding buildings group four, in terms of energy consumption saving (refer to section 19.2.2.5) must be done in either of these methods:

- Method A (System performance method) which can be used for all the buildings and is based on total annual energy consumption (section 19.3.1)
- Method B (Prescriptive Method) which can be used only for residential buildings of one to nine floors, separately or in complexes and with infrastructure of less than 2000 square

meters and buildings of group 3 in terms of energy consumption saving value. In this method two technical procedures are presented as B1 and B2 (section 19.3.2)

19.2.5. Designing Mechanical systems

Regulations of designing and selecting the equipments for energy efficiency of mechanical systems and hot water of buildings have been mentioned in section 19.4. Observing all these regulations in all the buildings with occupancy announced in attachment 4; is compulsory.

19.2.6. Designing lighting System

For lighting with electrical consumption, in buildings with occupancies announced in attachment 4, in addition to observing regulations of topic 13 of national building regulations, it is necessary to observe articles of section 19.5. of this subject.

19-3 Building envelope

A considerable portion of the building heat transfer is done via building envelope. In this chapter, the regulations for designing building envelope, for energy efficiency, are explained. These regulations are presented in sections 19-3-1 and 19-3-2 in the form of two methods; method A (System Performance) and method B (prescriptive).

System Performance method can be used in designing and calculating thermal insulation of envelope in all types of buildings, but prescriptive method is only applicable for calculating thermal insulation of envelopes of residential buildings with 1 to 9 floors, either individual or complex type, and with floor area less than 2000 m² and also buildings group 3, based on the energy saving.

19-3-1 Method A- System Performance Method

This method can be used for all types of buildings, however the building design by using this method, requires building envelope's heat transfer calculation. In the cases mentioned above prescriptive method (chapter 19-3-2) can be used.

In order to calculate thermal insulation of the buildings by using system performance method, the building category based on the energy saving should be specified first. The building category is determined based on principle (primary) specific factors (chapter 19-2-2) and the table in attachment 5 of this code. Then the buildings' thermal insulation size should be determined through calculation of the "Building heat transfer coefficient (H)" and comparing it to the maximum allowable one (reference heat transfer coefficient (·)).

The method of calculation of · and H is explained in chapters 19-3-1-1 and 19-3-1-3 respectively.

Figure **A1-1** also shows the flowchart of calculation steps of building envelope's thermal insulation by system performance method.

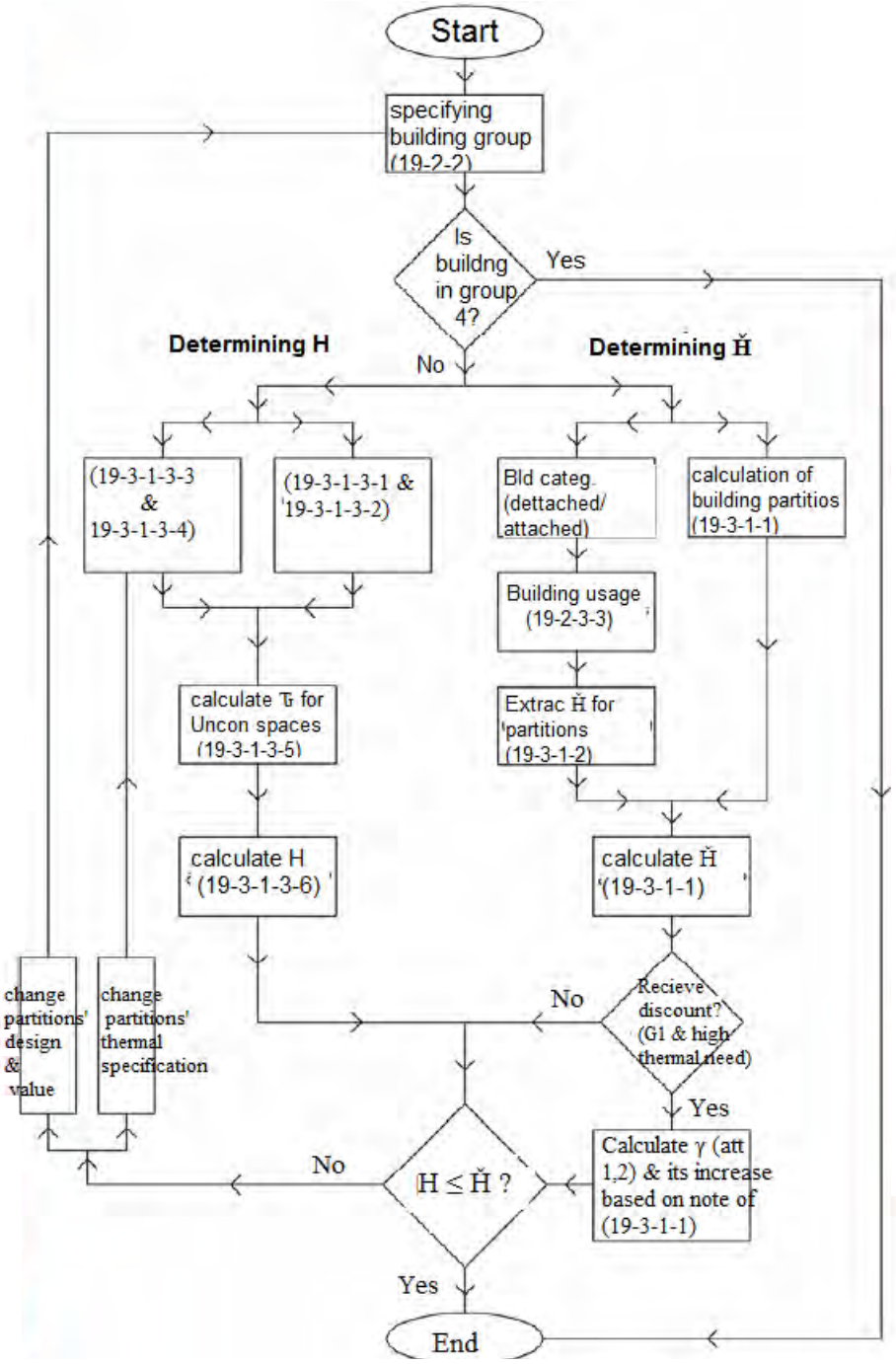


Figure A1-1 Flowchart of building envelope's thermal insulation calculation steps using system performance method

Calculations must be done separately for each individual building or apartment unit. If the building units have the same thermal specifications, the calculations can be done based on some index units. It should be mentioned that the building units are considered the same provided that:
- The thermal specifications for all building envelopes of the building units are the same;
- The type of cooling, heating and hot water supply system is the same in all units;
- The units have the same type of occupancy.

19-3-1-1 Calculation of Reference heat loss (transfer) coefficient:

Building heat transfer coefficient (·) based on [W/K] is equal to maximum allowable heat transfer

from building envelope, in steady state conditions and per one degree Celsius temperature difference between inside and outside air.

In calculating ·, heat transfer from roofs, walls, floors adjacent to air or soil and translucent layers of the building are considered. These partitions may be adjacent to the outside space, unconditioned spaces or soil.

For determining the heat reference heat transfer coefficient for a building it is necessary to extract reference heat transfer coefficients of the building envelope's components from chapter 19-3-1-2 tables considering the building category (chapter 19-2-2), building occupancy (chapter 19-2-3-2) and attached or detached status of the building (according to the definitions in page 5).

Moreover, it is necessary to calculate values of the building envelope components (including net area of all walls, roof, floor adjacent to air, door, window, and surfaces adjacent to unconditioned spaces and the perimeter of the floor adjacent to soil considering the internal dimensions[1].

After passing the abovementioned steps, the building's reference heat transfer coefficient (·) will be calculated through the following equation:

$$\cdot = (A_W \times \hat{U}_W) + (A_R \times \hat{U}_R) + (A_F \times \hat{U}_F) + (P \times \hat{U}_P) + (A_G \times \hat{U}_G) + (A_D \times \hat{U}_D) + (A_{WB} \times \hat{U}_{WB})$$

In which:

- A_W: overall area of the walls adjacent to outside space [m²]
- $\hat{U}_W$: reference surface heat transfer coefficient of the walls [W/m²K]
- A_R: overall area of the flat or pitched roofs adjacent to outside space [m²]
- $\hat{U}_R$: reference surface heat transfer coefficient of pitched or flat roof [W/m²K]
- A_F: overall area of the bottom floor adjacent to outside air [m²]
- $\hat{U}_F$: reference surface heat transfer coefficient of the basement floor adjacent to outside air [W/m²K]

1- In calculation of ·, just the thermal bridge of the floor adjacent to soil is considered.

- P: overall perimeter of the bottom floor adjacent to soil, outside space [m]
- $\hat{U}_P$: reference linear heat transfer coefficient of the basenebt floor adjacent to outside air [W/mK]
- A_G: overall area of the translucent layers adjacent to outside (glass and frame surfaces) [m²]
- $\hat{U}_G$: reference surface heat transfer coefficient of the translucent layers with their frames [W/m²K]
- A_D: overall area of the doors adjacent to outside space [m²]
- $\hat{U}_D$: reference heat transfer coefficient of the doors [W/m²K]
- A_{WB}: overall area of the surfaces adjacent to unconditioned space [m²]
- $\hat{U}_{WB}$: reference surface heat transfer coefficient of the partitions adjacent to unconditioned space [W/m²K]

Explanations:

1- The areas of all building partitions (A_W, A_R, A_F, A_D, A_{WB}) and the perimeter of the bottom floor adjacent to soil (P) are calculated from inner side.

2- All reference heat transfer coefficients of the building elements are presented in chapter 19-3-1-2.

3- "The wall adjacent to the outside space" means a partition which is located between a conditioned space and outside space. Also "wall adjacent to unconditioned space" is a partition which is located

between a conditioned and an unconditioned space (Figure **A1-2**). In calculating ·, the areas of the partitions between unconditioned and outside space is not considered.

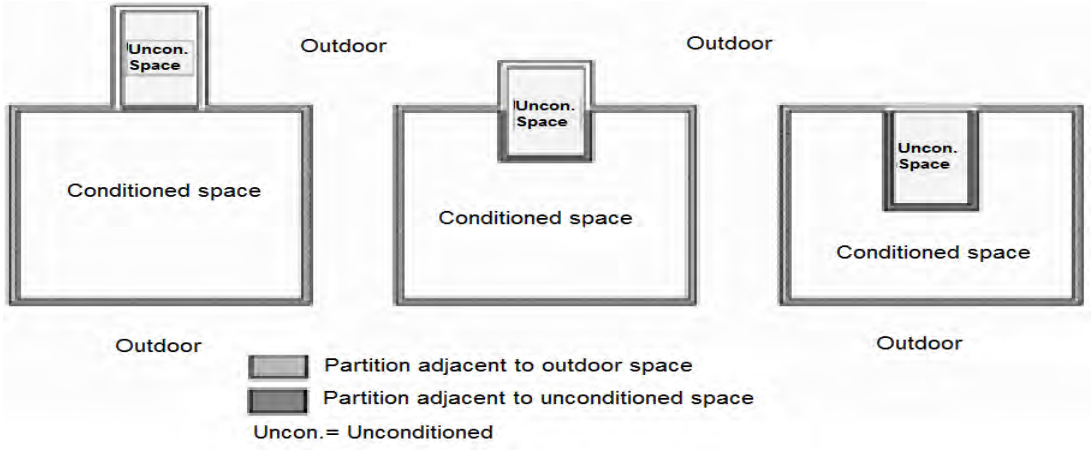


Figure A1-2 The status of the partitions adjacent to outside and unconditioned space in schematic plan of 3 sample buildings

Note 1: In regions with high heating need (according to attachment 3) the calculated reference heat transfer coefficient can be increased to γ.V [W/Kelvin]. In this equation "V" is the volume of building's usable space and "γ" is reference heat transfer coefficient correction factor.

The γ values are specified based on building's thermal inertia and solar index. For attached buildings with continuously used spaces γ is extracted from table 1 and for attached buildings with discontinuously used spaces from table **A1-1**.

The method of specifying building's thermal inertia and solar index is presented in attachment 1 and 2 respectively.

Table A1-1 Calculation of γ factor for attached buildings with continuously used spaces based on building's thermal inertia and solar index

Thermal inertia	Solar index		
	$I_S < 0.01$	$0.01 \leq I_S < 0.02$	$I_S \geq 0.02$
Low	0	0.03	0.06
Average	0	0.05	0.10
High	0	0.06	0.12

Table A1-2 Calculation of γ factor for attached buildings with discontinuously used spaces based on building's thermal inertia and solar index

Thermal inertia	Solar index		
	$I_S < 0.01$	$0.01 \leq I_S < 0.02$	$I_S \geq 0.02$
Optional	0	0.04	0.08

19-3-1-2 Reference heat transfer coefficients for the building elements of building envelope

Reference heat transfer coefficient for the building elements of building envelope is written in table 3 to 5 based on building category, occupancy and state of being attached or detached.

In order to calculate building's reference heat transfer coefficient $(\cdot)$ it is necessary to extract heat transfer coefficients of building envelope's elements from tables mentioned and put them in the equation in chapter 19-3-1-1.

Table A1-3 Reference heat transfer coefficient for building elements* for building group 1 (buildings with high requirements of EE & C)

Type of building & occupancy / Building elements		Individual detached Dwelling	Attached Building with continuous application	Attached Building with discontinuous application
Wall	$\hat{U}_W$	0.7	0.8	1.1
Flat or pitched roof	$\hat{U}_R$	0.3	0.5	0.55
Earthen air-contiguous floor	$\hat{U}_F$	0.45	0.5	0.55
Periphery of earthen soil-contiguous floor	$\hat{U}_P$	1.45	1.45	1.6
Translucent layer	$\hat{U}_G$	2.7	2.7	3.4
Door	$\hat{U}_D$	3.5	3.5	3.5
Partitions (layers) adjacent to unconditioned space	$\hat{U}_{WB}$	0.55	0.55	0.7

*All values are in [W/m²K] except $\hat{U}_P$ that is in W/mK.

Table A1-4 Reference heat transfer coefficient for building elements* for building group 2 (buildings with medium requirements of EE & C)

Type of building & occupancy / Building elements		Individual detached Dwelling	Attached Building with continuous application	Attached Building with discontinuous application
Wall	$\hat{U}_W$	0.88	1.01	1.39
Flat or pitched roof	$\hat{U}_R$	0.38	0.63	0.69
Earthen air-contiguous floor	$\hat{U}_F$	0.57	0.63	0.69
Periphery of earthen soil-contiguous floor	$\hat{U}_P$	1.83	1.83	2.02
Translucent layer	$\hat{U}_G$	3.4	3.4	4.28
Door	$\hat{U}_D$	4.41	4.41	4.41
Partitions (layers) adjacent to unconditioned space	$\hat{U}_{WB}$	0.69	0.69	0.88

*All values are in [W/m²K] except $\hat{U}_P$ that is in W/mK.

Table A1-5 Reference heat transfer coefficient for building elements* for building group 3 (buildings with low requirements of EE & C)

Type of building & occupancy / Building elements		Individual detached Dwelling	Attached Building with continuous application	Attached Building with discontinuous application
Wall	$\hat{U}_W$	1.02	1.17	1.61
Flat or pitched roof	$\hat{U}_R$	0.44	0.73	0.8
Earthen air-contiguous floor	$\hat{U}_F$	0.66	0.73	0.8
Periphery of earthen soil-contiguous floor	$\hat{U}_P$	2.12	2.12	2.34
Translucent layer	$\hat{U}_G$	3.94	3.94	4.96
Door	$\hat{U}_D$	5.11	5.11	5.11
Partitions (layers) adjacent to unconditioned space	$\hat{U}_{WB}$	0.8	0.8	1.02

*All values are in [W/m²K] except $\hat{U}_P$ that is in W/mK.

Note 2: If a building holds the most cooling need based on attachment 3 and all translucent layers of the building envelope have the overhangs determined in attachment 10, reference heat transfer coefficients of building elements can be increased by 1.1 factor.

19-3-1-3 Calculation of building heat transfer coefficient (H) and control building envelope properties

After determining reference heat transfer coefficient (·), it is necessary to calculate heat transfer coefficient (H) and compare it to ·. Heat transfer coefficient should be determined following the steps written in chapters 19-3-1-3-1 to 19-3-1-3-6 and compared to · according to what is mentioned in chapter 19-3-1-3-7.

19-3-1-3-1 Calculation of the area of building envelope's elements

In order to calculate heat transfer coefficient the values of all elements of building envelope, which has different thermal specifications or are adjacent to different spaces in terms of temperature control, should be calculated individually. These values include net area of walls, roofs, floors adjacent to air, doors and windows which are adjacent to outdoor space or unconditioned spaces. For the calculation of the areas, the internal dimensions of spaces should be the criteria.

19-3-1-3-2 Calculation of perimeter of thermal bridges of the building envelope

Along with calculation of the different elements of building envelope it is required to measure the length of thermal bridges in the building envelope. The values of thermal bridges are as follows:

- Perimeter of floor and wall adjacent to soil
- Perimeter of the underside floors
- Perimeter of the intermediate ceilings (which should be multiplied by 2)
- Perimeter of the final ceilings

- Length of indoor and outdoor walls' joints (which should be multiplied by 2)
- Length of the openings and translucent layers' joints

It should be mentioned that it is possible not to calculate thermal bridges' length if it is considered to omit accurate and separate calculation of thermal bridges for accelerating and simplifying the operations; however, in this case, it is necessary to increase heat transfer coefficient of the building elements that have thermal bridge according to the values presented in table 32 of attachment 11.

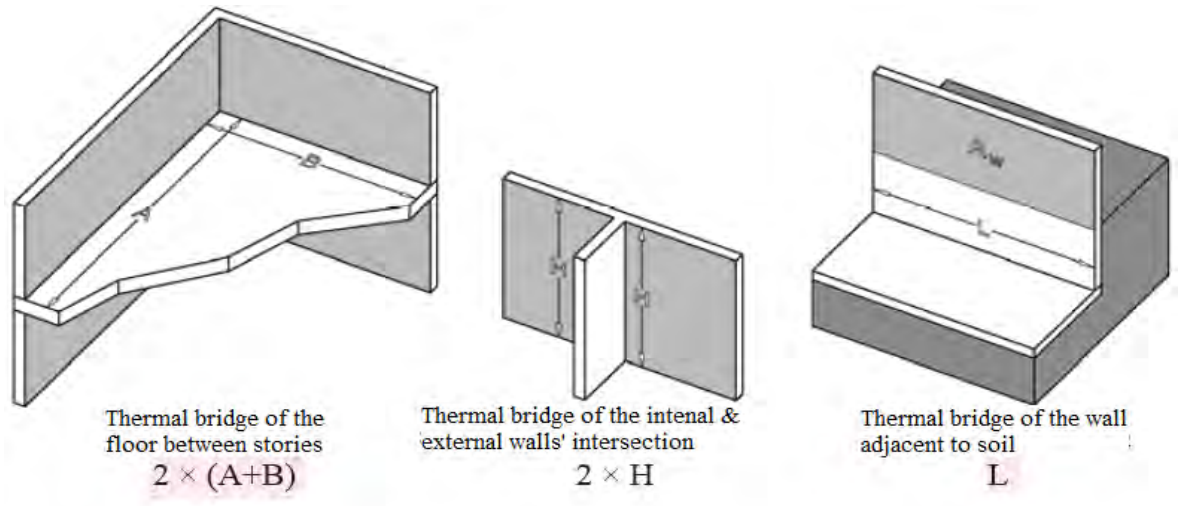


Figure A1-3 The design of some thermal bridges in the building envelope

19-3-1-3-3- Calculating and extracting heat transfer coefficient of the envelope's elements

Another measure in determining H is to calculate or extract surface heat transfer coefficient (U) for all building envelope's elements.

The heat transfer coefficient of the opaque walls should be calculated using the thermal conductivity of the common material (attachment 7) and thermal resistance of building pieces, air layers, and inside or outside surfaces of the building envelope (attachment 8). It is required to determine heat transfer coefficient of the openings and translucent layers of the building envelope according to tables presented in attachment 9 of this manual.

If the values for specific material or elements are not presented in the abovementioned attachments or a manufacturer claims that he has supplied products with thermal specifications better than what is mentioned in the credible sources, the technical license for the desired product must be attached to the documents.

This technical license must include thermal conductivity or thermal resistance coefficients of the products, with the thicknesses used in designing building and other technical specifications needed for comprehensive evaluation of the product and its executive regulations. In this case, the values mentioned in technical license are the criteria for designing and calculations, as long as it is credible.

19-3-1-3-4- Extracting linear heat transfer coefficient of thermal bridges

In addition to calculation of heat transfer coefficient of envelope's elements, it is needed to determine

linear heat transfer coefficient of thermal bridges using attachment 11.

It should be explained that if, for accelerating and simplifying the process, there is no tendency to do accurate and separate calculation of thermal bridges, it is possible to increase heat transfer coefficient of the building elements which have thermal bridges regardless of extracting linear heat transfer coefficient of thermal bridges and using the values specified in table 32 of attachment 11.

19-3-1-3-5- Calculation of heat transfer coefficient reduction factor (τ) of the unconditioned spaces

In addition to what have been mentioned so far, heat transfer coefficient reduction factor of all building's unconditioned spaces should be determined.

Regarding that the temperature difference between indoor space and unconditioned spaces is less than the one between indoor and outdoor spaces and therefore the amount of heat transfer coefficient for partitions adjacent to unconditioned spaces is less than the one from partitions adjacent to outdoor space, this issue must be included in calculations using a reduction factor.

Thus, it becomes important to determine heat transfer coefficient reduction factor of each unconditioned space and include it in calculating heat transfer coefficient of the elements adjacent to theses spaces. Heat transfer coefficient reduction factor for an unconditioned space is calculated from the following equation:

$$\tau = \frac{\Sigma A_e U_e}{\Sigma A_e U_e + \Sigma A_i U_i}$$

in which:

τ : Heat transfer coefficient reduction factor of unconditioned space
A_e: Net area of the partition between unconditioned space and outdoor [m²]
U_e: Heat transfer coefficient of partition between unconditioned space and outdoor [W/ m²K]
A_i: Net area of the partition between unconditioned and conditioned space [m²]
U_i: Heat transfer coefficient of partition between unconditioned and conditioned space [W/ m²K]

It should be noted that if, for accelerating and simplifying the process, accurate calculation of heat transfer coefficient reduction factor is neglected, it can be considered as equal to 1 for that space.

19-3-1-3-6- Calculation of building heat transfer coefficient

After above steps, building heat transfer coefficient (H) determined by calculating the summation of different envelope elements areas multiplied by heat transfer coefficient and heat transfer coefficient reduction factors of each of them and also the sum of products of thermal bridges' perimeters multiplied by linear heat transfer coefficient and their corresponding heat transfer coefficient reduction factor. This is mentioned by the following equation:

$$H = \sum_{i=1}^{n} (A_{Wi} \times U_{Wi} \times \tau_i) + \sum_{i=1}^{n} (A_{Ri} \times U_{Ri} \times \tau_i) + \sum_{i=1}^{n} (A_{Fi} \times U_{Fi} \times \tau_i) + \sum_{i=1}^{n} (A_{Gi} \times U_{Gi} \times \tau_i) + \sum_{i=1}^{n} (A_{Di} \times U_{Di} \times \tau_i) + \sum_{i=1}^{n} (P_i \times \psi_i \times \tau_i)$$

in which

- A_{Wi}: Net area of each kind of walls adjacent to outdoor or unconditioned space [m²]
- U_{Wi}: Heat transfer coefficient corresponding to each kind of walls [W/m²K]
- A_{Ri}: Net area of each kind of flat or pitched roofs adjacent to outdoor or unconditioned space [m²]
- U_{Ri}: Heat transfer coefficient corresponding to each kind of flat or pitched roofs [W/m²K]
- A_{Fi}: Net area of each kind of underside floors adjacent to outdoor air or unconditioned [m²]
- U_{Fi}: Heat transfer coefficient corresponding to each kind of underside floors adjacent to air [W/m²K]
- A_{Gi}: Net area of each kind of translucent layers and their frames, adjacent to outdoor or unconditioned space [m²]
- U_{Gi}: Heat transfer coefficient corresponding to each kind of translucent layers [W/m²K]
- A_{Di}: Net area of each kind of external doors or adjacent to unconditioned space [m²]
- U_{Di}: Heat transfer coefficient corresponding to each kind of external doors [W/m²K]
- P_i: Perimeter of each kind of floors adjacent to soil and thermal bridge [m]
- ψ_i: Linear heat transfer coefficient corresponding to kinds of floors adjacent to soil and thermal bridges [W/m K]
- τ_i: Heat transfer coefficient reduction factor for each partition

Explanations:

1- "Partition adjacent to outdoor space" means a partition which is located between a conditioned space and the outdoor. "Partition adjacent to uncontrolled space" also refers to a partition located between conditioned and unconditioned space (Figure A1-2). In the equation above, area of the partitions and thermal bridges between unconditioned and outdoor space is not considered (included).

2- Heat transfer coefficient reduction factor for the partitions adjacent to outside space is equal to1.

3- Heat transfer coefficient reduction factor for each of the partitions adjacent to unconditioned space is equal to the calculated heat transfer coefficient reduction factor for that unconditioned space (chapter 19-3-1-3-5). If it is not desired to do the above calculation, heat transfer coefficient reduction factor for the walls adjacent to that space should be considered 1.

4- If the designer wants to do thermal insulation for the partitions between unconditioned and outdoor space (Figure A1-4 B), he should put all partitions between these two spaces in the above equation instead of partitions between the mentioned unconditioned space and conditioned spaces. In this case, for the walls between that unconditioned space and outdoor, 1- τ_i should be included in the calculation instead of τ_i . If τ_i of the unconditioned space is not calculated, it is necessary to suppose one as τ_i of these elements and put it in the equation.

19-3-1-3-7- Comparison of H and ·

After calculating building heat transfer coefficient it is compared to reference heat transfer coefficient. In system performance method building thermal insulation should be designed in a way that H is less than or equal to ·. If the H is more than ·, thermal specifications or building element values should be modified in order to reduce H.

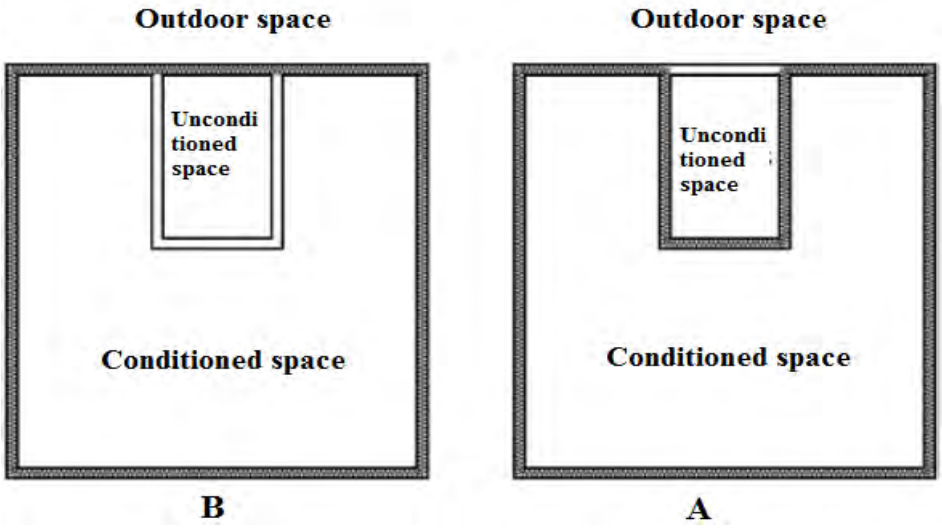


Figure A1-4
A: Thermal insulation of the walls adjacent to outdoor and unconditioned space
B: Thermal insulation of the walls adjacent to outdoor and walls between unconditioned and outdoor space

19-3-2 Method B- Prescriptive method

Designing with method B, in comparison with system performance method, is much easier. This method is applicable for 1-to-9-story residential buildings, either individual or complex and with the floor area less than 2000 m², and buildings group 3 in terms of energy saving.

In this method the minimum acceptable thermal specifications of the building envelope's partitions, according to the building category from the energy saving point of view (refer to chapter 19-2-2-5), is presented in the following two technical solutions and it is obligatory:

B- 1) set of technical solutions, using super-windows (pages 37-42); which has been considered for building that have necessary requirement for using prescriptive method and are located in groups 1, 2 and 3.

B- 2) Set of technical solutions, using ordinary windows (pages 43-46); which has been considered for building that have necessary requirement for using prescriptive method and are located in either groups 2 or 3.

According to technical solutions B-1, building's translucent layers should be of superior kinds in terms of thermal specifications; while based on technical solutions B-2 using ordinary windows is also allowed but the building's walls should have more thermal resistance comparing to solutions B-1. Table 6 shows the qualitative ranking of windows in building thermal insulation according to prescriptive method.

Table A1-6 Qualitative ranking of windows in building thermal insulation according to prescriptive method*

Ranking		Sash material	Glass type	Widow quality
Super	1	UPVC	Ordinary or low-E double-layer	With technical license
		Aluminum thermal break	Low-E double layer	With technical license
	2	UPVC	Ordinary or low-E double-layer	-

		Aluminum thermal break	Ordinary double-layer	With technical license
		Wooden	Ordinary or low-E double-layer	With technical license
Ordinary	3	All kinds	All single-layer types	-

* this categorization is only based on heat transfer but not air leakage.

19-3-2-1 The requirements in technical solutions of prescriptive method

In each set of technical solutions the following requirements are specified for thermal specifications of building partitions:

1- Minimum thermal resistance, in both status of wall adjacent to outdoor or unconditioned space, and based on thermal insulation method (external, internal, central, or equal);

2- Minimum thermal resistance of roof, in both status of roof adjacent to outdoor or unconditioned space and based on method of thermal insulation of building's roof and walls;

3- Qualitative ranking of building's translucent layers;

4- Minimum thermal resistance of floor adjacent to air, in both status of being adjacent to outdoor or unconditioned space and based on method of thermal insulation of the floor adjacent to air and building's walls;

5- Acceptable thermal insulation method for floor on the soil (overall or peripheral) and minimum thermal resistance of the thermal insulation being used.

19-3-2-2- The effect of proper utilization of sunshine

If the building with the necessary requirements for the prescriptive method has high thermal need according to attachment 3 and the suitable utilization of solar energy is possible based on chapter 19-2-3-1, the minimum thermal resistances presented in technical solutions can be reduced by coefficient of 0.95.

19-3-2-3- The effect of using suitable overhangs

If the building with the necessary requirements for the prescriptive method has high cooling need according to attachment 3 and all translucent layers of building envelope have the overhangs determined in attachment 10, the minimum thermal resistances presented in technical solutions can be reduced by coefficient of 0.9.

19-3-2-4- Some points about prescriptive method technical solutions

The following issues should be considered about sets of technical solutions mentioned in chapters 19-3-2-5 and 19-3-2-6:

- In thermal insulating of non-residential buildings of group 3 which are used discontinuously (refer to 19-2-3-2) only the internal thermal insulation methods and its corresponding values can be used.

- The thermal resistance values given for walls, roof and floor adjacent to air are for the whole thickness of partitions, therefore it is necessary to determine thermal resistance of the insulation using the values mentioned in technical solution and considering thermal resistance of other partition layers.

- The thermal resistance values given for the floor on soil is only related to thermal insulation layer.

- In unconditioned spaces, instead of insulating the partitions adjacent to building's unconditioned space (Figure A1-4 A) the designer can focus on insulating all partitions between that unconditioned space and outdoor (Figure A1-4 B) using the value and specification determined for partitions adjacent to outdoor.

- For those building's partitions that is separated from neighboring building with a separating gap the following points should be observed:

a) If the separating gap is completely covered and we are sure that the neighboring building's spaces are controlled, those partitions do not need to be thermally insulated, but if we have no information about the temperature control of the neighboring building, the partition adjacent to it is considered to be adjacent to unconditioned space.

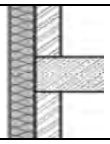
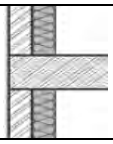
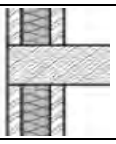
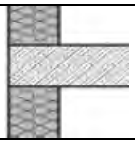
b) If the gap between two buildings is not covered, the partition adjacent to it will be considered as the one adjacent to outdoor space.

- For those building's side partitions which is hanged to the neighboring building without a separating gap, they do not need thermal insulation if the spaces of that building are conditioned, but if the temperature control of the neighboring building is not clear, the partition adjacent to it is considered to be adjacent to unconditioned space.

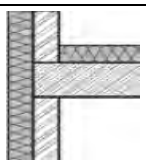
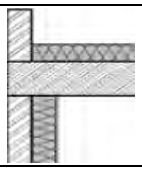
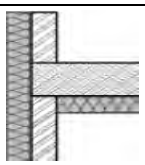
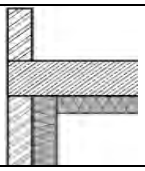
19-3-2-5- Prescriptive Technical solutions B-1 (with super windows)

19-3-2-5-1- Buildings group 1 in terms of energy saving rate

a- Minimum thermal resistance of walls [m².K/W]

Wall adjacent to outdoor space				Wall adjacent to unconditioned space
External thermal insulation	Internal thermal insulation	Central thermal insulation	Equal thermal insulation	
				
1.2	2.3	2.3	2.1	1.0

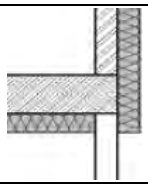
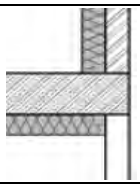
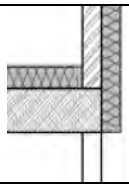
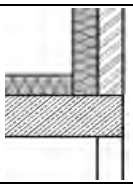
b- Minimum thermal resistance of roof or ceiling [m².K/W]

Roof or ceiling adjacent to outdoor space				Roof or ceiling adjacent to unconditioned space
Roof or ceiling external thermal insulation		Roof or ceiling internal thermal insulation		
With external or central insulation of wall	With central or equal insulation of wall	With external or central insulation of wall	With central or equal insulation of wall	
				
3.0	3.0	3.0	2.1	1.0

c- Minimum specifications of translucent layers

According to table 6, all translucent layers adjacent to outdoor should be in the 1st qualitative ranking. The translucent layers adjacent to unconditioned spaces can be selected from either the 1st or 2nd or 3rd ranking.

d- Minimum thermal resistance of floor adjacent to air [m².K/W]

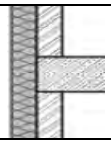
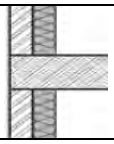
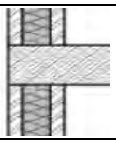
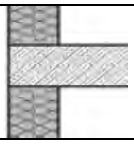
Floor adjacent to outdoor space				Floor adjacent to unconditioned space
Floor external thermal insulation		Floor internal thermal insulation		
With external or central insulation of wall	With central or equal insulation of wall	With external or central insulation of wall	With central or equal insulation of wall	
				
3.2	3.2	3.2	2.1	0.9

e- Minimum thermal resistance of insulation of the floor adjacent to soil of conditioned spaces [m².K/W]

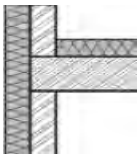
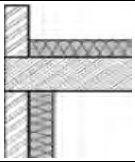
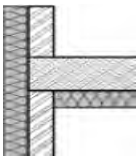
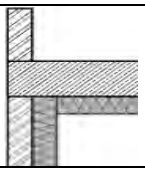
The status of building floor		
More than 40 cm above surroundings	Less than 40 cm above or same level or below surroundings	
Overall insulation	Overall insulation	Peripheral insulation with at least 70 cm width
0.9	0.7	1.1

19-3-2-5-2- Buildings group 2 in terms of energy saving rate

a- Minimum thermal resistance of walls [m².K/W]

Wall adjacent to outdoor space				Wall adjacent to unconditioned space
External thermal insulation	Internal thermal insulation	Central thermal insulation	Equal thermal insulation	
				
0.9	1.5	1.5	1.4	0.8

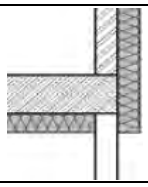
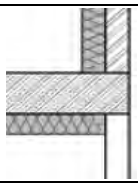
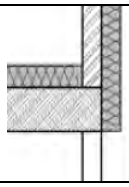
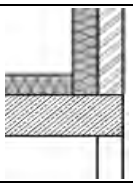
b- Minimum thermal resistance of roof or ceiling [m².K/W]

Roof or ceiling adjacent to outdoor space				Roof or ceiling adjacent to unconditioned space
Roof or ceiling external thermal insulation		Roof or ceiling internal thermal insulation		
With external or central insulation of wall	With central or equal insulation of wall	With external or central insulation of wall	With central or equal insulation of wall	
				
2.1	2.1	2.1	1.6	0.8

c- Minimum specifications of translucent layers

According to table 6, all translucent layers adjacent to outdoor should be in the 1st or 2nd qualitative ranking. The translucent layers adjacent to unconditioned spaces can be selected from either the 1st or 2nd or 3rd ranking.

d- Minimum thermal resistance of floor adjacent to air [m².K/W]

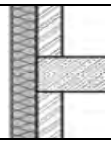
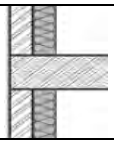
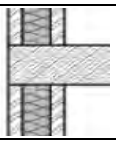
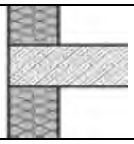
Floor adjacent to outdoor space				Floor adjacent to unconditioned space
Floor external thermal insulation		Floor internal thermal insulation		
With external or central insulation of wall	With central or equal insulation of wall	With external or central insulation of wall	With central or equal insulation of wall	
				
2.2	2.2	2.2	1.5	0.7

e- Minimum thermal resistance of insulation of the floor adjacent to soil of conditioned spaces [m².K/W]

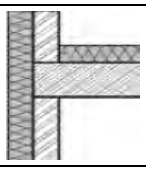
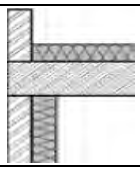
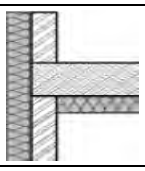
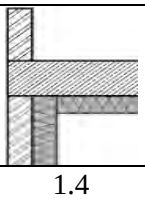
The status of building floor					
More than 100 cm above surroundings		40-100 cm above surrounding		Less than 40 cm above or same level or below surroundings	
Overall insulation	Peripheral insulation with at least 100 cm width	Overall insulation	Peripheral insulation with at least 70 cm width	Overall insulation	Peripheral insulation with at least 50 cm width
0.7	0.9	0.5	0.7	0.3	0.5

19-3-2-5-3- Buildings group 3 in terms of energy saving rate

a- Minimum thermal resistance of walls [m².K/W]

Wall adjacent to outdoor space				Wall adjacent to unconditioned space
External thermal insulation	Internal thermal insulation	Central thermal insulation	Equal thermal insulation	
				
0.8	1.2	1.2	1.1	0.7

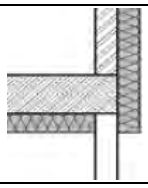
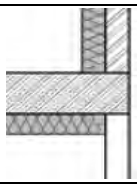
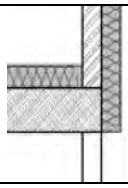
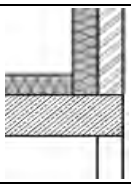
b- Minimum thermal resistance of roof or ceiling [m².K/W]

Roof or ceiling adjacent to outdoor space				Roof or ceiling adjacent to unconditioned space
Roof or ceiling external thermal insulation		Roof or ceiling internal thermal insulation		
With external or central insulation of wall	With central or equal insulation of wall	With external or central insulation of wall	With central or equal insulation of wall	
				
1.7	1.7	1.7	1.4	0.7

c- Minimum specifications of translucent layers

According to table 6, all translucent layers adjacent to outdoor should be in the 1st or 2nd qualitative ranking. The translucent layers adjacent to unconditioned spaces can be selected from either the 1st or 2nd or 3rd ranking.

d- Minimum thermal resistance of floor adjacent to air [m².K/W]

Floor adjacent to outdoor space				Floor adjacent to unconditioned space
Floor external thermal insulation		Floor internal thermal insulation		
With external or central insulation of wall	With central or equal insulation of wall	With external or central insulation of wall	With central or equal insulation of wall	
				
1.7	1.7	1.7	1.3	0.6

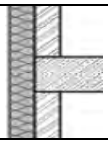
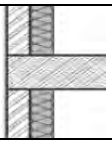
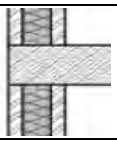
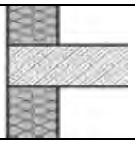
e- Minimum thermal resistance of insulation of the floor adjacent to soil of conditioned spaces [m².K/W]

The status of building floor				
More than 100 cm above surroundings		40-100 cm above surrounding		Less than 40 cm above or same level or below surroundings
Overall insulation	Peripheral insulation with at least 70 cm width	Overall insulation	Peripheral insulation with at least 50 cm width	Thermal insulation of the wall on soil of the conditioned spaces is not necessary
0.2	0.5	0.2	0.3	

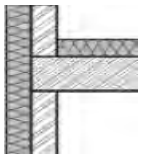
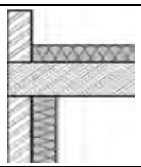
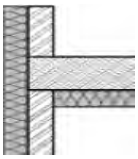
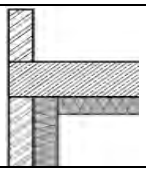
19-3-2-6- Prescriptive Technical solutions B-2 (with ordinary windows)

19-3-2-6-1- Buildings group 2 in terms of energy saving rate

a- Minimum thermal resistance of walls [m².K/W]

Percentage of translucent layers' area to external walls	Wall adjacent to outdoor space				Wall adjacent to unconditioned space
	External thermal insulation	Internal thermal insulation	Central thermal insulation	Equal thermal insulation	
					
16-20	2.5	Not allowed	Not allowed	Not allowed	0.8
11-15	1.7	4.9	4.9	4.1	0.8
10& less	1.4	3.2	3.2	2.8	0.8

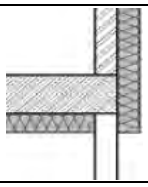
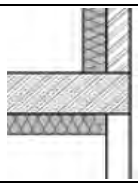
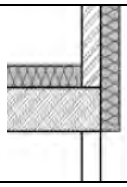
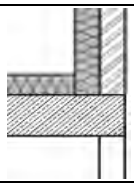
b- Minimum thermal resistance of roof or ceiling [m².K/W]

Thermal resistance values of roof are independent from ratio of translucent layers' area to external walls	Roof or ceiling adjacent to outdoor space				Roof or ceiling adjacent to unconditioned space
	Roof or ceiling external thermal insulation		Roof or ceiling internal thermal insulation		
	With external or central insulation of wall	With central or equal insulation of wall	With external or central insulation of wall	With central or equal insulation of wall	
					
	2.1	2.1	2.1	1.6	0.8

c- Minimum specifications of translucent layers

If the area of the translucent layers of conditioned spaces is equal to or less than 20 percent of overall area of the building's external walls, windows of the 3rd ranking (according to table 6) can be used by observing the requirements determined in this chapter. Otherwise technical solutions B-1 for this group (chapter 19-3-2-5-2) will be used.

d- Minimum thermal resistance of floor adjacent to air [m².K/W]

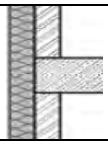
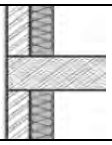
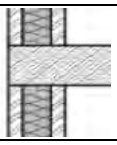
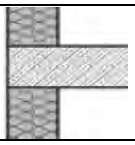
Thermal resistance values of roof are independent from ratio of translucent layers' area to external walls	Floor adjacent to outdoor space				Roof or ceiling adjacent to unconditioned space
	Floor external thermal insulation		Floor internal thermal insulation		
	With external or central insulation of wall	With central or equal insulation of wall	With external or central insulation of wall	With central or equal insulation of wall	
					
	2.2	2.2	2.2	1.5	0.7

e- Minimum thermal resistance of insulation of the floor adjacent to soil of conditioned spaces [m².K/W]

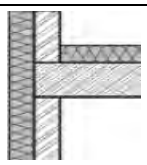
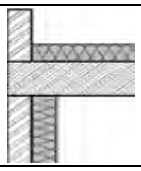
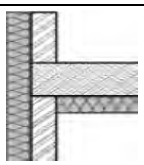
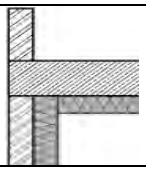
The status of building floor					
More than 100 cm above surroundings		40-100 cm above surrounding		Less than 40 cm above or same level or below surroundings	
Overall insulation	Peripheral insulation with at least 100 cm width	Overall insulation	Peripheral insulation with at least 70 cm width	Overall insulation	Peripheral insulation with at least 50 cm width
0.7	0.9	0.5	0.7	0.3	0.5

19-3-2-6-2- Buildings group 3 in terms of energy saving rate

a- Minimum thermal resistance of walls [m².K/W]

Percentage of translucent layers' area to external walls	Wall adjacent to outdoor space				Wall adjacent to unconditioned space
	External thermal insulation	Internal thermal insulation	Central thermal insulation	Equal thermal insulation	
					
21-25	1.8	5.7	5.7	4.6	0.7
16-20	1.4	3.2	3.2	2.8	0.7
11-15	1.2	2.4	2.4	2.1	0.7
10& less	1.1	2.0	2.0	1.9	0.7

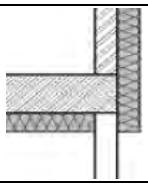
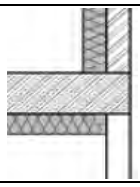
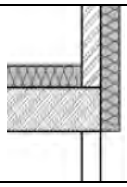
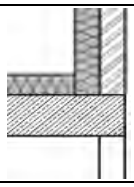
b- Minimum thermal resistance of roof or ceiling [m².K/W]

Thermal resistance values of roof are independent from ratio of translucent layers' area to external walls	Wall adjacent to outdoor space				Wall adjacent to unconditioned space
	Roof or ceiling external thermal insulation		Roof or ceiling internal thermal insulation		
	With external or central insulation of wall	With central or equal insulation of wall	With external or central insulation of wall	With central or equal insulation of wall	
					
	1.7	1.7	1.7	1.7	0.7

c- Translucent layers

If the area of the translucent layers of conditioned spaces is equal to or less than 25 percent of overall area of the building's external walls, windows of the 3rd ranking (according to table 6) can be used by observing the requirements determined in this chapter. Otherwise technical solutions B-1 for this group (chapter 19-3-2-5-3) will be used.

d- Minimum thermal resistance of floor adjacent to air [m².K/W]

Thermal resistance values of roof are independent from ratio of translucent layers' area to external walls	Floor adjacent to outdoor space				Roof or ceiling adjacent to unconditioned space
	Floor external thermal insulation		Floor internal thermal insulation		
	With external or central insulation of wall	With central or equal insulation of wall	With external or central insulation of wall	With central or equal insulation of wall	
					
	1.7	1.7	1.7	1.7	0.6

e- Minimum thermal resistance of insulation of the floor adjacent to soil of conditioned spaces [m².K/W]

The status of building floor				
More than 100 cm above surroundings		40-100 cm above surrounding		Less than 40 cm above or same level or below surroundings
Overall insulation	Peripheral insulation with at least 70 cm width	Overall insulation	Peripheral insulation with at least 50 cm width	Thermal insulation of the wall on soil of the conditioned spaces is not necessary
0.2	0.5	0.2	0.3	

19-3-3- Recommendations on designing buildings

Architectural design of the building should be at least compatible with the climate in order to gain maximum use of suitable natural conditions and facilities. Moreover the building should be protected from undesirable climatic conditions so that the least energy is used for supplying thermal comfort, through cooling and heating and it can partially be supplied by nature and passive systems. In addition to thermal insulation some effective measures in utilizing natural energies in building are as follows:

- Building orientation (direction)
-General volume and form of the building
- Location of internal spaces
- Translucent layers
- Overhangs
- Thermal inertia of partitions
- Natural ventilation

19-3-3-1- Building orientation

The building orientation toward south is very effective for utilizing solar energy in a building. Proper orientation is when the southern translucent layers are exposed to sun radiation for more utilization of sun radiation energy in the shortest day of the year (from 9 am to 3 pm). Moreover the building should be located in a way that it is protected from undesired winds during a year and in hot season of the year the desired winds can be used for natural ventilation and maintaining thermal comfort conditions.

19-3-3-2- General volume and form of the building

General volume and form of the building is very effective on transferring thermal energy. The less the ratio of building envelope to its floor area is, the less the building heat transfer will be. It is recommended to design condensed buildings in regions with high energy demand (according to attachment 3) and reduce the ratio of the building envelope area to its floor area. In hot and humid climates or regions with high cooling demand (according to attachment 3), the building should be designed in a way that it becomes possible to use natural ventilation for all indoor spaces.

19-3-3-3- Location of interior spaces

The interior spaces of a building can be divided into two categories; main and retaining. The main spaces are the ones that are used in most times of a day and people live in them. Retaining spaces do not hold residents and are not continuously used. These two types of spaces can be put in a way that the retaining spaces are located between main spaces and building's undesired facades (thermally) so that the heat transfer from main spaces to outside in the cold seasons of the year (or from outside to main spaces in the hot seasons) can be reduced to minimum. The main spaces should be exposed to desired building facades. The desired building facades according to their importance are: southern,

eastern, and northern. By locating main spaces toward south a portion of needed heating can be supplied by sunshine in the cold seasons.

19-3-3-4- Translucent layers

Translucent layers including windows, skylights and so on should be of high-grade frames without direct gap and with the minimum air leakage. It is highly recommended to use common glasses or the ones with super thermal specifications (low-E, ….), either multi-layer type or with two parallel frames for these layers especially windows.

The frames of these layers should be made of suitable material such as wood, polymers, or metal with minimum thermal bridges. If the sealing round the frames are not suitable, sealing tapes should be used in order to prevent air leakage.

The amount of translucent layers is very important in terms of heat transfer in building. The less the ratio of translucent layer area to the building envelope area is, the less heat will transfer outside in cold seasons of the year. The adequate and proper amount of translucent layers will decrease the heat transfer to outside in addition to providing suitable lighting for interior spaces. The southern translucent layers help absorbing solar energy for supplying a portion of needed heating in the cold seasons. It is better for these layers not to be exposed to the cold and undesirable facades of building because they have little thermal resistance comparing to other parts of building envelope. The specifications of translucent layers are shown in attachment 9.

19-3-3-5- Overhangs

Overhangs (sunshades) are used for controlling the rate of sun radiation to building's translucent layer. They are not necessarily needed in all regions. For determining this need the region climate should be studied precisely. The angle of vertical or horizontal overhangs should be specified based on the hot seasons of the year and sun radiation angle in these periods. Thus whole surface of window will be covered by shade and the overhang prevents the direct radiation of sun inside the building and consequently temperature increase and uncomfortable thermal conditions in building's interior space.

The dimensions of an overhang should be in a way that it can prevent sun radiation into the building in the hot seasons and it is possible for the sun radiation to enter the buildings in the cold seasons.

The suitable angles for windows' overhangs, for each of 216 regions, are presented in attachment 10. In tables of this attachment, for each city, the angles of horizontal and vertical overhangs are determined for different orientation status of windows. The depth of vertical and horizontal overhangs can easily be measured by extracting these angles and knowing window dimensions.

19-3-3-6- Thermal inertia

Some building elements such as floor, ceiling or walls that have high thermal capacity (high mass) or thermal inertia can store heat. Because of thermal inertia the heating or cooling which exist in the space is transferred to that element and returned to it when cooling or heating is needed. Therefore it prevents the excessive temperature fluctuation in the inside space. The need to thermal elements with high thermal capacity depends on how that space is being used. In spaces that are continuously used during a day high thermal inertia is needed and it is recommended to do thermal insulation on the outer side of the building envelope. But in spaces with discontinuous use in a day thermal inertia is better to be as low as possible and thermal insulation from inner side of the building envelope is recommended. The details of calculating thermal inertia are presented in attachment 1.

19-3-3-7- Natural ventilation

Providing the conditions for natural ventilation in buildings causes better supply of thermal comfort and reduces energy consumption of mechanical systems. This is especially important in humid regions.

In designing buildings in humid regions it is recommended to provide moderate conditions in spaces by setting face-to-face openings and not blocking the airway with building elements. In hot and humid regions it is better to take some measures, like creating shade, in order to reduce air temperature before going into the building's interior spaces.

In hot and dry regions the natural ventilation at night will cool the material mass. During the day, the ventilation of the interior spaces, with the air cooled by simple evaporating systems, supplies a considerable portion of building's cooling needs.

19-4 Mechanical installations

In addition to the points mentioned in article 14 of the national building codes, for saving energy in mechanical installation, it is necessary to observe the following issues:

19-4-1 General regulations

In this chapter the general strategies and considerations for reducing the energy needed for buildings' mechanical installations is mentioned.

a) It is recommended to apply active or passive systems and equipments which benefit from renewable energy sources such as the solar or the geothermal.

b) The equipments that provide thermal and cooling needs, air conditioning and warm water such as heaters, coolers, heating pumps, pumps, water heaters, fans, and different parts of engine rooms must have energy label.

c) The controlled areas of a building must not be directly connected with uncontrolled areas or outer space and they must properly be separated by the use of doors or such other separators. In crowded controlled areas the doors must also be automatic.

d) In hotels, hospital, offices and the buildings with the same application it is necessary to prepare a system to stop the heating or cooling installations automatically whenever the separators are open for a long time.

e) In the independent building units whose cooling, heating and warm water are produced by a joint system, it is recommended to install an energy-consumption counter for each unit so that the effect of strategies used for reducing energy consumption can separately be measured for each of them.

f) In building of group one, if the energy need of a part of the building or a part of it's systems is high, installing separate counters is obligatory.

g) The inner temperature of the spaces, at the presence of people, must be adjusted at most 20 degree Celsius in the cold months and at least 28 degree Celsius at the hot months of the year. In the humid areas, the inner temperatures in the hot months of the year must be based on the case and not be less than 25 degree Celsius in any condition. For the spaces with the special conditions, it is not necessary to obey the mentioned regulations and the temperatures of heating or cooling adjustment must be specified based on the case.

Note: In case of the water coolers following the regulation of base temperature is not needed.

h) In buildings like industrial buildings which controlling the temperature of the whole inner space is not necessary, thermal comfort requirements must be supplied locally.

19-4-2- Heating and cooling installations:

19-4-2-1- Supplying cooling and heating

Cooling and heating of a building may be provided in 2 ways: central or independent. Engine rooms and packages are considered central systems and heaters and window coolers are independent. However, the installations' capacity and technical properties must be specified based on the measurements of heating and cooling loads and using installations with a capacity higher than what is needed should be prevented as far as possible.

Necessities of each of the central and independent systems are presented in chapters 19-4-2-1-1 and 19-4-2-1-2.

19-4-2-1-1- Central system

a) In the heating and cooling central systems, thermostats must be used in order to control the air temperature or water coming out of each system.

b) Temperature control is done via adjustment of the turn off and on timing for heating and cooling installations (burner, compressor), or controlling their capacity or adjusting active flowing current (by pump and electrical tap)

c) The active flowing pump is controlled or turned off and on based on the air temperature or returned water.

d) The temperature adjustment switch for controlling system must be automatically adjustable corresponding to the building's external temperature.

e) For all buildings of group 1 and 2 with the useful infrastructure of more than 1000 square meters (see attachment 5), it is obligatory to consider a system of planning installations' round-the-clock operation considering exploitation times. It is also recommended for other building groups.

f) In all cooling systems the energy coefficient required for air replacement which is calculated via the following formula must never be less than 5:

$$\text{Air replacement energy coefficient} = \frac{\text{System's replaced sensible cooling load (W)}}{\text{Electrical energy inputted into system fans (W)}}$$

The above formula is applicable to all full air and water-air systems and fan coils. For water-air systems, pumps' electrical energy should be added to the denominator for the electrical input to the fans.

g) Installations that need to use energy in order to supply humidity and retain the comfort conditions in buildings must be controlled by humidity sensors.

h) If a part of the nonresidential building spaces with interrupted exploitation is used permanently, cooling and heating of these spaces must be separated from the central system and considered independent.

19-4-2-1-2- Independent system

a) Any type of non-central cooling or heating system which completely work independent must be turned off and on by a thermostatic control.

Note: For kerosene (oil) heaters this rule does not need to be observed.

b) Fire places are allowed to be installed adjacent to the interior walls: and it must be completely separated from building's exterior wall. It is recommended to erect an automatic control system for opening dampers while the fire place is on.

19-4-2-2- Distributing circuits

Distributing circuits transfer and distribute the produced cold or heat to the terminals. It is compulsory to balance the cooling or heating systems circuits. For this purpose, required equipments including dampers, thermometers, barometers, and balance valves should be used.

For cooling and heating installations, insulation of water, air and steam distribution systems is compulsory.

19-4-2-2-1- Pipes thermal insulation

All pipes used in cooling and heating systems must be insulated according to table 7. To make sure of the minimum thickness of thermal insulation, using pre fabricated thermal insulators is recommended. One must avoid compressing and reducing the nominal thermal resistance of the insulator at the time of its installation.

Table A1-7 Minimum thermal resistance of pipe insulator in cooling and heating systems [m².k/w]

Fluid Type	Pipe diameter ≤ 38 mm	Pipe diameter > 38 mm
Warm water	0.88	1.32
Steam	1.00	2.0
Cold water, refrigerant, brine	0.88	1.00

19-4-2-2-2- Channels thermal insulation

All channels used in cooling and heating must be insulated by an insulator with thermal resistance of at least 0.88 [m².k/w] if they are located inside the building space. If the channels are located outside the building, they must be insulated by an insulator with thermal residence of at least 1.44 [m².k/w]. In the case of water cooler channels inside the building, thermal insulation is not needed.

19-4-2-3- Cooling and heating terminals

a) For all cooling and heating system terminals such as radiators, fan coils, and dampers (in air systems), it is recommended to install thermostatic controls.

b) Thermal and cooling terminal fans must have the capability of being turned on and off by a thermostatic control system with the adjustability of different temperature in one day (24 hrs)

c) In non residential buildings considering a central system to control functions of the fan during 24 hours is obligatory.

19-4-3- Air conditioning systems

19-4-3-1- Supplying fresh air

All fresh air supplying systems, which works with the use of a blower or fan must be equipped with an on-and-off switch so that they can be turned off in non-operational condition or when fresh air is not required, unless they are equipped with automatic control.

In all areas of air entrance and exit in buildings, considering automatic systems whose dampers are open only at operation times, are obligatory. In case that the degree of inside air pollution varies, automatic adjustment of the amount of fresh air is obligatory.

Maximum amount of mechanical ventilation must not be more than 20% more than the minimum determined ventilation in terms of health and hygiene. If heat recovery systems from exit air are used in buildings, this limitation will be averted (omitted).

19-4-4-3-2- Quality of openings' joint sealing

In each independent unit, if the amount of unwanted air conditioning which is done by openings such as doors and windows normally does not exceed from one third of air change per hour, heat transfer coefficient of the source $\hat{H}$ in paragraph 19-3-1-1 can be increased up to 10%. The amount of unwanted air conditioning is determined by related sources.

Point: if the amount of unwanted ventilation is reduced through applying different maneuvers (like using new windows, and types of crack blockers), the fresh air required for supplying health and hygiene should be provided naturally or mechanically.

19-4-4- Consumption warm water installations

19-4-4-1- General considerations

a) In central heating system, designing and execute of consumer warm water installations must be done separately or it's separate operation by electrical tabs with automatic control must be possible.

b) It is recommended to use solar systems for pre-heating of the water and reducing the consumption of fossil fuels.

c) In water heaters provided with a tank which do not have pumps, using heat traps is recommended.

d) Equipments of consumer warm water system must be equipped with a temperature control system. The temperature of warm water should not be more than 60 degree Celsius. In the swimming pools which water temperature is controlled, water temperature should not be more than 27 degree Celsius.

e) The water heaters for specific applications, like swimming pools' water heaters should be equipped with an on-and-off switch not connected to thermostat.

f) It is obligatory to use an automatic controller to turn off the returned water pump when warm water is not needed.

g) For application of water purification pump, it is compulsory to use time controller. It is recommended not to use the pump at the peak hours of network load.

h) Pouring water from sinks and shower heads should not be more than 0.16 liter/sec at the pressure of 550 kPa (about 5.5 bar or atm).

i) Use joint cold and warm water tabs as much as possible.

j) In buildings with public applications, using springy tabs or tabs with photoelectric cells is obligatory.

19-4-4-2- Thermal insulation of pipe and tank

a) In consumer warm water systems, pipes must have a thermal insulator with thermal resistance of more than 0.88 [m^2.k/w].

b) Warm water tanks must have thermal insulator with thermal resistance of more than 1.00 [m^2.k/w].

c) In public swimming pools which use warm water, using cover is obligatory. In case of private pools of residential buildings which utilize warm water, using this cover is recommended.

19-5- Lighting system and electrical energy

In providing lighting by the use of electrical energy, it is necessary to observe the contents of this chapter in addition to the article 13 of the national building codes. Moreover, solar cells can also be used independently or parallel to the entire electricity grid for supplying a portion of building's electrical energy.

19-5-1- Lighting systems and equipments

In public spaces of all buildings which use electrical lighting continuously, it is compulsory to use energy saving lamps (high efficient) with the minimum efficiency of 55 lumen/ watt. Using these lamps in all interior spaces of residential buildings, which use continuous electrical lighting especially in the living rooms and kitchens, is recommended.

All lighting systems installed in or on the ceiling must have reflectors so that they provide maximum lighting.

19-5-2- Lighting control systems

19-5-2-1- Lighting of the spaces

Each independent space must have a separate control system or switch that:

1- is located at the space's entrance or exit, visible and available

2- by looking at them it can be realized that the lamp is on or off.

These requirements are not true about lamps that are used merely for decoration.

19-5-2-2- Systems of reducing time or rate of lighting

Lighting of surrounded areas which has an area of 10 m² or more and their lighting load is more than 12 watt/m² and is supplied by more than one source, must be controlled such that the lighting load of lights is reduced by half while the lighting level is still supplied with acceptable equality in the whole space. The reduction of lighting in an equal manner should be supplied in one of the following ways:

1. Using light dimmers to control all lighting systems
2. Controlling the odd and even rows by two switches
3. Supplying independent switch for the center lamp of three-lamp systems
4. Supplying an independent switch for each lamp or each set of lamps.
5. Using movement or attendance diagnosing systems.
6. Using adjustable timed systems or systems that automatically turn off.

About surrounded spaces which take benefit of enough natural light during the day, in addition to above mentioned ways, it is recommended to have at least one artificial light control system in order to control lighting system in the part profited by natural light.

19-5-2-3- Lighting turn off control

In each area of building lighting, lighting systems must be controllable by one or more central switches which are installed by hand in the place. It is also recommended to use automatic switch (movement or attendance diagnosing systems or time control). Observing this rule is not necessary in the following cases:

a) Lighting of halls, lobbies or entrance areas which lack security lighting.

About security lighting systems the rules of national building codes 13 must be taken into consideration.

b) Areas with specific applications such as department stores and commercial complexes, restaurants, mosques, theatres, cinemas and similar buildings.

If a timer switch system is expected, following conditions is needed:

- It must be easily visible and available;
- It must be in a place where it can easily be noticed that the switch is for which space;
- It also works manually.

If a time programmable system is being used, the system must have the capability of getting special programs according to annual calendar.

19-5-3- Lighting intensity of spaces

Lighting intensity of spaces and different applications in buildings must be specified based on national building codes 13. In order to supply this lighting intensity, it must be noticed that lamps with high quotient coefficient, lamps with high productivity, and proper facilities should be used in a way that density of electrical energy (Watt/ m^2) for providing desired lighting is optimum.

19-5-4- Lighting of the surroundings and outside area of the building

19-5-4-1- Lamps

Lamps used for lighting of the surroundings and outside area of the building must have the efficiency of at least 50 Lumen/ watt.

19-5-4-2- Controlling surroundings and outside lighting

For surroundings of buildings that are not used in 24 hours or for the whole week it is obligatory to use automatic controllers or photo cells for turning the lights on and off.

19-5-5- Counter

In complexes, it is obligatory for each independent unit to be equipped with a separate counter for separate measurement of electricity consumption rate.

19-5-6- Motors (Engines)

Any kind of electrical motors must conform to the regulations of Iran Industrial Research and Standard Institute. Using Motors with variable speeds in installations like pumps, blowers, and power electronic tools, and adjusting the frequency proportional to variable load and reducing electrical energy consumption of the motors is highly recommended.

PROPOSALS

Annex 2	Improvement for energy efficiency labeling system (continue)
Annex 3	Focus on research and development for high energy efficiency appliance (Continue)
Annex 4	Introduction of award related EE&C
Annex 5	Formation and activation of an ESCO market
Annex 6	Building a Database (Database of building information)
Annex7	Program for Promotion of EE&C architectural technology
Annex 8	Establishment of Financing Instrument for ESCO Business
Annex 9	Establishment of the Training Center for EE&C for the Building Sector
Annex 10	Competency Map

OTHER

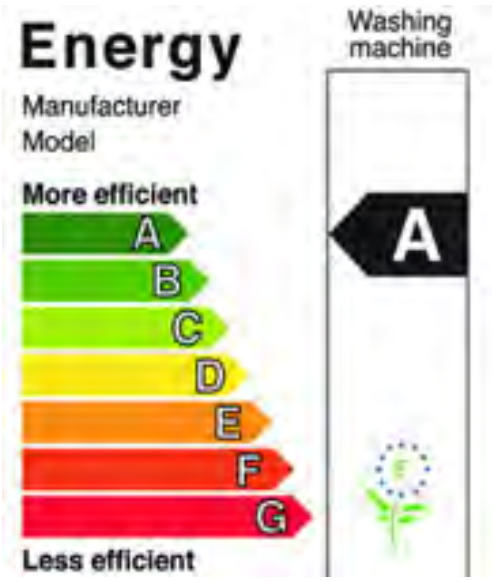
Annex11	Cmparison of Inst. Of Higher Education and Research Complex

Annex 2 Improvement for energy efficiency labeling system (continue)

High energy efficiency appliance is one of the basic items in EE & C on both building sector and factory sector.

In Iran, from about 15 years before, energy efficiency labeling system started, useful information based on this system is indicated now on 17 kinds of appliance (e.g. the electric bulb) which are marketed, and in order to help good selecting to purchaser.

The standard for labeling is prepared by the committee that consists of MOI, MOE, MOP & ISIRI. It will be finally approved by the Criteria Approval Committee which consists of MOI, MOE, MOP & ISIRI and the representative of the beneficiary party. ISIRI will be responsible for implementation of the approved standards for the appliances in the country. Although SABA and ISIRI inspect and check EE & C performance of appliances, it is important to take this measure continuously in the future.



7. Trademark
8. Name of company
9. Name of model
10. Energy efficiency grade
    7 grades :
    Most efficient is A,
    Worst efficient is G
11. Rated energy consumption
12. General information
    Capacity of appliance,
    Registration to ISO, etc

Figure A2-1 Image of the energy labeling in Iran

However, current energy efficiency labeling system of Iran is relative evaluation to other products. It is desirable for the Iranian government to show a target and to promote the further EE &C. It appropriates to add new information for absolutely evaluation, since current labeling system has already been spread and well-known.

■ Image of energy efficiency labeling system in Japan

In Japan, Government office shows the target fiscal year and target numerical value for EE &C achievement. And the label shows the evaluation on an absolute scale to a target.
Thereby, Government office can control the target of EE & C in appliance development actively.

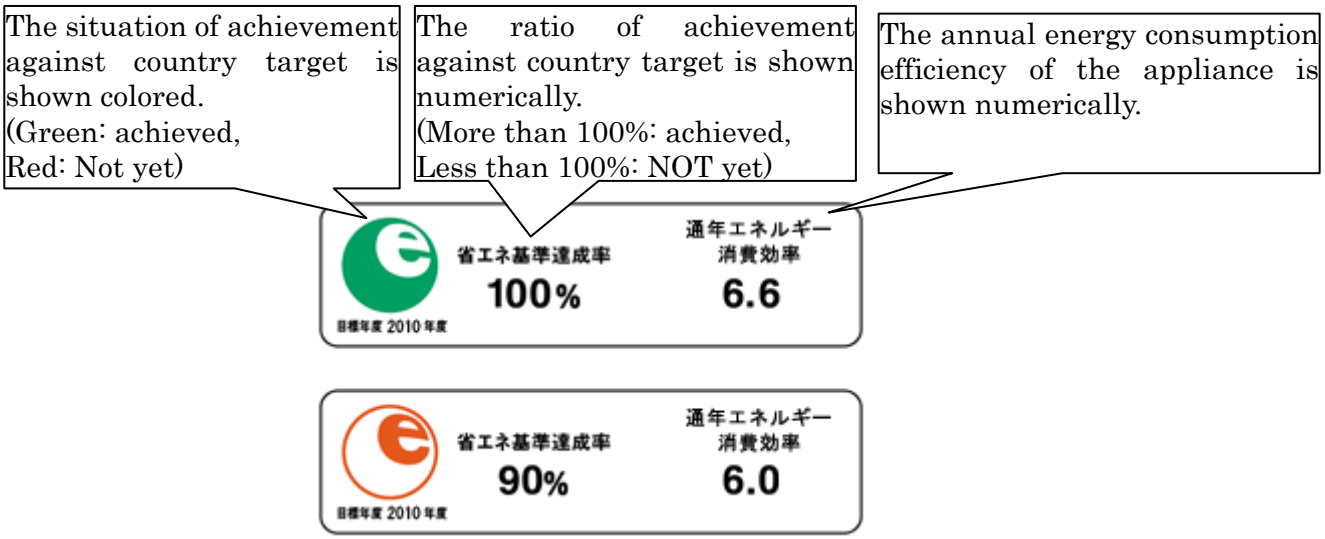


Figure A2-2 Image of energy efficiency labeling system in Japan

Annex3 Focus on research and development for high energy efficiency appliance (Continue)

High energy efficiency appliance is one of the basic items in EE & C on both building sector and factory sector.

About development of high energy efficiency appliance, Iranian government has already tackled and SABA is performing development of high energy efficiency appliance with the maker actively now. However, the budget currently assigned is not enough for continuation of a maker's development volition.

Although several percent of the budget is to be assigned to research and development in Iranian government organization, based on notification by Managing and Planning Organization, in order to promote EE &C powerfully, special budget is important.

Issue in current situation and suggestion for improvement in this theme is shown below.

■ Issues in current situation
1) Possibility that plan may be changed, with change of the top of SABA. (Cultural background)
2) Few funds currently assigned to development of high energy efficiency appliance.
3) Short term development. (Within fiscal year)
4) Selecting just major company. (The small company which needs fund offer truly is not selected)

■ Suggestion for improvement
1) Since it is not influenced by change of the top of an organization, this theme is positioned as a main policy.
2) The fund to development of high energy efficiency appliance is increased. (NOT ordinary budget, but special budget)
3) The long-term development over two or more years
4) The framework from which the outstanding idea is selected (Irrespective of the track record and scale of a company.)

Annex 4 Introduction of award related EE&C

In order to advance EE&C in building sector, it is required that excellent product in the EE&C performance is in circulation, many engineers well versed in EE&C are trained and the building owner utilize both. It is so useful that the excellent activities are commended officially and are announced widely, in order to raise makers, engineers and Building owners' awareness of EE&C. The outstanding activities are as follows, for example, e.g. the excellent product in the EE&C performance, the engineer done excellent activities about EE&C through O&M and maintenance to equipment and the building which actually introduced EE&C measures and achieved high EE&C effect.

In Iran, the energy efficiency labeling system to appliance has been already carried out, and the introduction of the energy efficiency labeling system to building will be considered from now on. These measures are useful for a bottom raising. On the other hands, award system is aimed at promoting the further improvement in capability of the product etc. which are located in a higher rank by commending the product etc. which are located in a higher rank in EE&C.

In Iran, since the consumer energy price doubled in connection with the subsidy abolished to the energy price in last year, the consciousness to energy saving is increasing. Such a situation resembles the situation which our country experienced in the 1970s, and as adopted in our country, it seems that introduction of the system which supports the activities about EE&C are useful.

(1) Establishment of EE&C Awards

1) Awarding of Excellent Energy Conservation Manager

The remarkable engineer of distinguished services who strove for promotion of EE&C over many years is commended.

2) Awarding of Excellent Energy Conservation Building

Energy saving in the whole building commends a remarkable building.

3) Awarding of Successful Case of Energy Conservation in Building

The successful case about the technology and the method that the EE&C effect is expected very much is commended. Moreover, the successful case about the EE&C activities and EE&C result in a school, a building, a hospital, a department store, a supermarket, an amusement park, etc. is commended.

4) Awarding of Successful Case of Energy Conservation in Home & Grass Roots Activities

The energy-saving practice activities which are tackling in the place of work and the school, and the community are commended. Target is an individual, a group, or an organization. In addition, in Iran, the poster contest for water saving, etc. have already been performed, and serve as a developed type of such an existing measure.

5) Awarding of Excellent Energy Conservation Appliance

By developing appliance and providing for practical use, the company accepted to contribute to promotion of the efficient utilization of energy is commended.

6) Energy Conservation Grand Prize for excellent energy conservation equipment

The excellent one among consumer appliance already produced commercially is commended.

Image of range covered by award is shown in Table below.

	Short term or small scale activities	Long term or large scale activities
Award to building		■ Awarding of Excellent Energy Conservation Building
Award to human	■Awarding of Successful Case of Energy Conservation in Building ■Awarding of Successful Case of Energy Conservation in Home & Grass Roots Activities	■ Awarding of Excellent Energy Conservation Manager
Award to appliance	■Awarding of Excellent Energy Conservation Appliance	■Energy Conservation Grand Prize for excellent energy conservation equipment

(2) Setting up independent committee

In order to guarantee that EE&C Awards will become just and upright, it is important that a member of the selection committee does not have an interest with a candidate or an organization of the Awards, and can judge the superiority or inferiority of each section with sufficient knowledge and experience. Moreover, it is important to specify the evaluation points for calculating of the points by the applicant himself and for eliminating arbitrary selection.

Summary of Introduction of award program Action Plan (Draft)

1. Name	Introduction of award related EE&C
2. Coauthor	SABA
3. Target	1) The owner of building which is carried out EE&C 2) Maker which develops advanced EE&C products 3) Manager in operation and maintenance who is carried out EE&C 4) Building user who is carried out EE&C
4. Object	Activities Activity for the social cognition and spread of EE & C technologies and products
5. Expected effect	Spread and promotion of the energy-saving technologies and the product in building sector, improvement in an advanced entrepreneur's motivation
6. Cost	
7. Period	1st term (FY2012 - FY2013), 2nd term (FY2014 - FY2015)

8. Item

This program newly establishes the award system related EE&C, and aims at spreading and promoting EE&C from the field of a building, human resource, and products.

1st term（2012～2013）

1) Award against EE&C activities on short term or small scale

- ✓ Awarding of Successful Case of Energy Conservation in Building
- ✓ Awarding of Successful Case of Energy Conservation in Home & Grass Roots Activities
- ✓ Awarding of Excellent Energy Conservation Appliance

2nd term（2014～2016）

1) Award against EE&C activities on short term or small scale

- ✓ Continued from 1st term

2) Award against EE&C activities on long term or large scale

- ✓ Awarding of Excellent Energy Conservation Building
- ✓ Awarding of Excellent Energy Conservation Manager
- ✓ Energy Conservation Grand Prize for excellent energy conservation equipment

9. Issues

- ✓ Construction of the system to evaluate activities

10. Necessity of technical support

- ✓ Not necessary

The Schedule

Item	2012	2013	2014	2015	2016	Remark
1st term						
-Foundation of criteria committee for award	▬					
- Awarding of Successful Case of Energy Conservation in Building	▬	▬	▬	▬	▬	
- Awarding of Successful Case of Energy Conservation in Home & Grass Roots Activities	▬	▬	▬	▬	▬	
- Awarding of Excellent Energy Conservation Appliance	▬	▬	▬	▬	▬	
2nd term						
- Awarding of Excellent Energy Conservation Building		▬	▬	▬		
- Awarding of Excellent Energy Conservation Manager			▬	▬	▬	
- Energy Conservation Grand Prize for excellent energy conservation equipment			▬	▬	▬	

Annex 5 Formation and activation of an ESCO market

Unlike situation for promotion of EE&C to industrial sector, 2 important situations for promotion of EE&C to building sector is insufficient, the first one is many engineers (human resource) who can suggest appropriately EE&C, the second one is adequate investment to introduction of EE&C. Therefore, even if a statute and a standard are enacted, EE&C is not promoted simply.

On the other hand, for implementation of EE&C on building, it is necessary that the building owner understand fully amount of amount of EE&C potential and amount of investment for introduction of EE&C. It is important to raise Building owner and motivation for EE&C of a company through education and enlightenment. However, the ESCO business, offered one package solution for introduction of EE &C including financing, plays a role important for EE&C promotion in the building sector.

Although the company related with EE&C business is registered into SABA as ESCO companies now, they don't have any experience of ESCO. In order to spread ESCO from now on, it is effective that independent ESCO Association is founded, make ESCO recognize socially, and activity for spread is performed.

Some main causes by which an ESCO market was not formed in Iran are mentioned below.

1) Can not become business with a cheap energy price

2) Few possibility of financing from a financial institution

3) ESCO contract is complicated and risk management is difficult (knowledge and experience are insufficient)

The situation is changing about the first reason, and since the consumer energy price doubled in connection with the subsidy abolished to the energy price in last year, the present situation is suitable for EE&C business. In order to form the ESCO market in such a situation, various managements are required. The following management policies have been performed in ESCO advanced nations including Japan.

(1) Estimate of ESCO Potential, feasibility study for ESCO

In Japan, feasibility study in connection with ESCO business introduction is performed with support of METI (Ministry of Economy, Trade and Industry) in 1996. It is a needed program in order to raise new industry like the ESCO business.

(2) Capacity development for ESCO companies

In Japan, under leadership of ECCJ (Energy Conservation Center, Japan) and JAESCO (Japan association of Energy Service Company), various manuals are prepared by them, are supplied information, e.g. introduction of best practice, are given award to excellent practice. In other Asian nations, under the support of cooperating organization, e.g. UNDP, many programs, such as

preparation of a guideline, capacity development of a financial institution, short course trainings to ESCO business companies, and preparation of a standard contract, are performed, and they are useful for an ESCO business company's improvement in capability. Since an understanding to the ESCO business of a financial institution is required in order to expand an ESCO market especially, the briefing session for a financial institution and training are needed.

(3) Enlightenment and spread

It is necessary that fundamental knowledge, e.g. role & effect & best practice of ESCO, is spread to ESCO business companies, building owners, and financial institution. In Japan, ECCJ and JAESCO have held various kinds of seminars, the complex, the exhibition, etc. Since ESCO is new corporate structure, obstacles, such as business practice, may be collided with. Enlightenment and spread is a powerful means which removes an obstacle. Capacity development, mentioned above (2), is related to enlightenment and spread.

(4) Project development

Following on feasibility study mentioned in (1), it is necessary to carry out energy audit for an ESCO project excavation, and to undertake the pilot project which serves as a model project in an early stage. Through a pilot project, a guideline and a standard contract are prepared and ESCO companies are improved capabilities, e.g. method of performance guarantee and M&V (Measurement and Verification). And, through making a database of energy audit, bringing out energy consumption trend by each building use, analyzing energy conservation potential, ESCO projects are excavated.

(5) Financial support

In order to expand ESCO market, it is important that financial institution understands to the ESCO business, but it takes long time to prepare financial environment. In the ESCO early stage (market formation), although demand for fund may be small, demand for fund will grow with the market expansion of ESCO. To the demand for fund in an ESCO early stage, it is appropriate that the measure against financial assistance, e.g. fund and low interested loan, is prepared by the government system or an international cooperation organization. Although the fund of a commercial financial institution is needed according to expansion of a market, when the government prepares a loan guarantee, the investment in the ESCO business is promoted.

(6) Introduction of ESCO for governmental building

Since the ESCO introduction for governmental building has big influence on formation of an ESCO market, it is so important to implement ESCO project smoothly in the earliest stage. But, in Japan, the ESCO introduction to governmental building is not progressing so much. In particular, to the ESCO introduction to state owned building, regulation, such as procurement rule and bidding condition, etc. serves as barrier. Therefore, through experience carrying out a pilot project in an early stage, it is required to improve the system, such as relaxation of regulations, for

introducing ESCO business smoothly.

Counter measure for formation and activation of ESCO market is shown Fig. below.

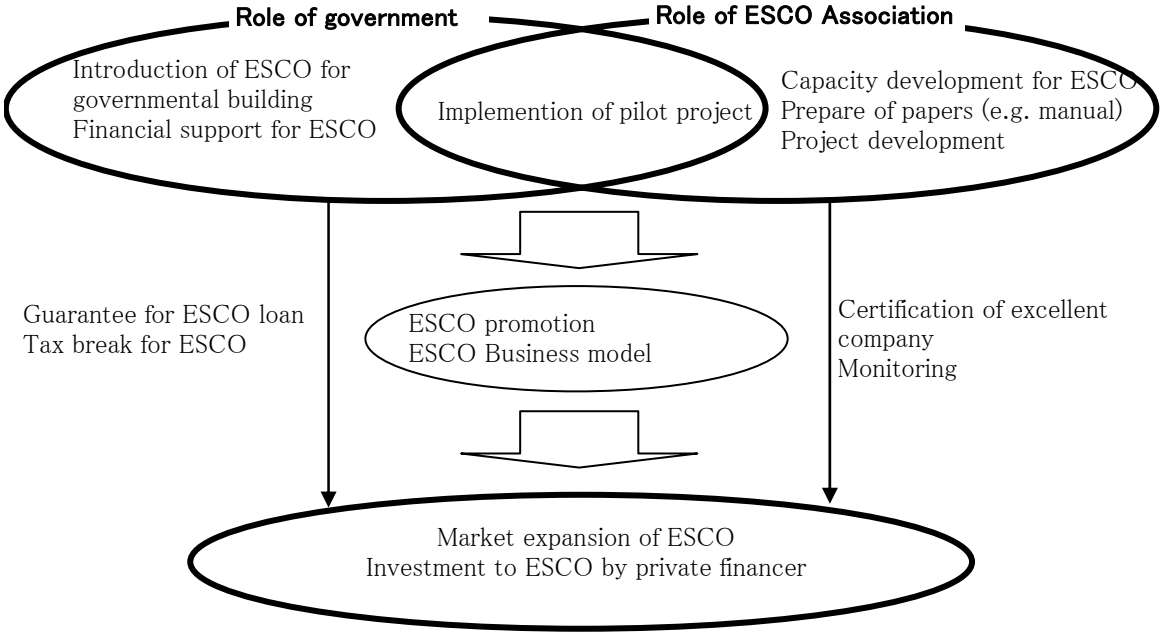


Figure A5-1 Counter measure for formation and activation of ESCO market

Mentioned above, project for formation and activation of an ESCO market is shown below.

- Foundation of ESCO Association for enlightenment and spread of ESCO
- Introduction of ESCO for governmental building (Implementation of pilot project)
- Financial support to ESCO (refer to Annex-8)

Summary of Foundation of ESCO Association Action Plan (Draft)

1. Name	Foundation of ESCO Association for enlightenment and spread of ESCO
2. Coauthor	MOE/OIPEEE
3. Target	1) Private companies related ESCO (ESCO companies) 2) Building owners
4. Object	Enlightenment and spread of ESCO
5. Expected effect	Promotion of EE&C to building sector and of EE&C business by spread of ESCO
6. Cost	
7. Period	1st term (2012～2013), 2nd term (2014, 2015)

8. Item

The purposes of this program are to develop the capacity of ESCO companies, to find the ESCO projects, to implement the promoting activities for growing ESCO market by foundation of ESCO Association.

1st term (2012～2013)

1) Foundation of ESCO Association

- ✓ An independent ESCO Association is founded under MOE, and ESCO companies are the registered in ESCO Association. In the first registration of the company, the company is registered by the report of a company outline, a financial situation, experience record concerning EE&C business, the number of engineers in the company, etc., without special examination.

2) Capacity development of ESCO

- ✓ The ESCO Association collects information related ESCO, such as ESCO example, from the foreign countries which are ESCO advanced nations, and give the information to the member companies.
- ✓ The ESCO Association studies an ESCO business scheme suitable for the business environment in Iran, through a periodical information exchange and study meeting.
- ✓ The ESCO Association builds a relation with ESCO Association of foreign countries, and shares information with the member companies.
- ✓ The ESCO Association makes the ESCO manual, the standard contract, the financial framework, etc. through the implementation of the pilot project of ESCO carry out the model project of ESCO to develop the capacity of member companies.

3) Promoting activities of ESCO

- ✓ The ESCO Association holds dispatch of the ESCO's information by a homepage, issue of a periodical magazine of ESCO, and the briefing session of ESCO in any place. And the ESCO Association promotes ESCO and gets the social cognition of ESCO by the above activities.
- ✓ The ESCO Association publicizes ESCO to a financial institution, and supports the new financial framework construction for the ESCO business.

2nd term (2014, 2015)

- ✓ Continuation of the first term
- ✓ Finding ESCO projects by energy audits and implementation of ESCO pilot projects
- ✓ ESCO award system
- ✓ Monitoring of ESCO project and certification of excellent company

9. Issues

- ✓ There is no specialist to develop the ESCO business in Iran, because of no experience of implementation of ESCO project.

10. Necessity of technical support

- ✓ In capacity development of the ESCO company in the first term, support by an ESCO specialist is needed from ESCO advanced nations.
- ✓ About establishment support of ESCO Association and dispatch of an ESCO specialist, Japan is an ESCO advanced nation, and the technical assistance of our country is possible enough to the first term.

The schedule

Main items	2012	2013	2014	2015	2016	Remark
- Foundation of ESCO Association						
- Capacity development of ESCO						
- Promotion of ESCO						
- Feasibility study, Implementation of pilot project						
- ESCO award system						
- Certification of excellent company, Monitoring						

Summary of Introduction of ESCO to governmental building Action Plan (Draft)

1. Name	Introduction of ESCO to governmental building
2. Coauthor	MOE/OIPEEE
3. Target	1) Central and local governments 2) ESCO companies
4. Object	Capacity development of ESCO companies and promoting ESCO business
5. Expected effect	Promotion of EE&C to building sector and of EE&C business by spread of ESCO
6. Cost	
7. Period	1st term (2012～2013), 2nd term (2014～2016)

8. Item

The purpose of this program is introduction of ESCO to governmental buildings positively for capacity development of ESCO companies. The implementation of ESCO in the governmental buildings builds an ESCO business scheme suitable for Iran, and ties to the promotion of energy saving of the building by the ESCO business.

1st term (2012～2013)

1) Energy audit of the governmental buildings

- ✓ The government introduces energy audit of the governmental buildings for the feasibility study of ESCO.
- ✓ The company which carries out the energy audit shall be ESCO company registered with ESCO Association. The company proposes ESCO through the audit.

2) Implementation of a pilot project of ESCO to the governmental buildings

- ✓ The government selects the buildings to introduce ESCO from the audit.
- ✓ ESCO companies study the ESCO business, such as the contract of ESCO, monitoring method of the saving by ESCO, guarantee method of the performance, and the risk of ESCO, by implementation of the pilot projects of ESCO.
- ✓ The governments gain a further understanding of ESCO from the pilot projects, and study the financial framework for ESCO projects.

3) Making an introduction manual of ESCO to governmental buildings

- ✓ The governments make a manual for introduction of ESCO to governmental buildings through the pilot projects. The contents of manual are the flow of introduction of ESCO, the standard contract, the risk allocation between the parties, and financing method.
- ✓ The central government strives for promotion of ESCO with holding a briefing session on the introduction of ESCO to local governmental buildings in collaboration with ESCO Association.

2nd term（2014～2016）

1) Feasibility study of ESCO for the governmental buildings

- ✓ The central and local governments conduct a feasibility study of ESCO for their buildings.

2) Implementation of ESCO for the governmental buildings

- ✓ The governments actively introduce ESCO to their buildings to form and extend the ESCO market in Iran.

9. Issues

- ✓ There is no specialist to introduction and to implementation of ESCO in Iran.
- ✓ It is necessary to carry out this program in parallel to support program for foundation of ESCO Association.

10. Necessity of technical support

- ✓ ESCO specialists are required for implementation of the pilot projects, and making the introduction manual. The technical assistance of our country is possible enough to the first term.

The Schedule

Main items	2012	2013	2014	2015	2016	Remarks
- Energy audit of the governmental buildings						
- Implementation of a pilot project						
- Making an introduction manual of ESCO						
- Feasibility study of ESCO						
- Implementation of ESCO						
-						

Annex 6 Development of a Database (Database of building information)

One of the essential measures to promote energy conservation is building a database. The database should include information about the condition of each building existing in Iran and its energy consumption.

The purpose of building database is to help in planning an appropriate energy conservation policy by understanding the energy consumption situation of the buildings in Iran. Utilization of the database also helps confirming an effect of implementing the energy conservation policy and formulating a new policy using the benchmark data from database

That is, database can provide a platform for continuously promoting energy conservation, by rotating the cycle of PLAN → DO → CHECK → PLAN (See diagram below).

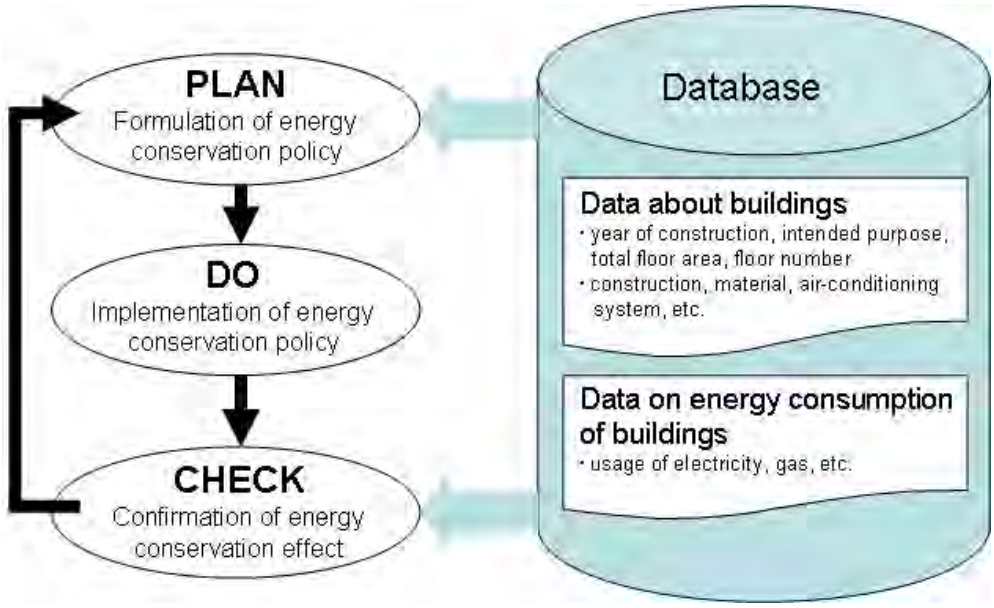


Figure A6-1 Meaning of the Database

To build a database, it is necessary to continuously acquire information about the condition and energy consumption of every building.

In Japan, building owner of the level must report the current situation of energy saving level every year. In Iran it is also decided to condition and energy consumption of every building from this March.

The most reliable method for this is to place an energy manager in every building. The role of energy manager is to update the database every year with the latest information, conduct activities for energy conservation of the building, record the energy consumption volume, and provide the updated information to the government every year. On the other hand, the government must train, educate, and certify the energy managers (See diagram below).

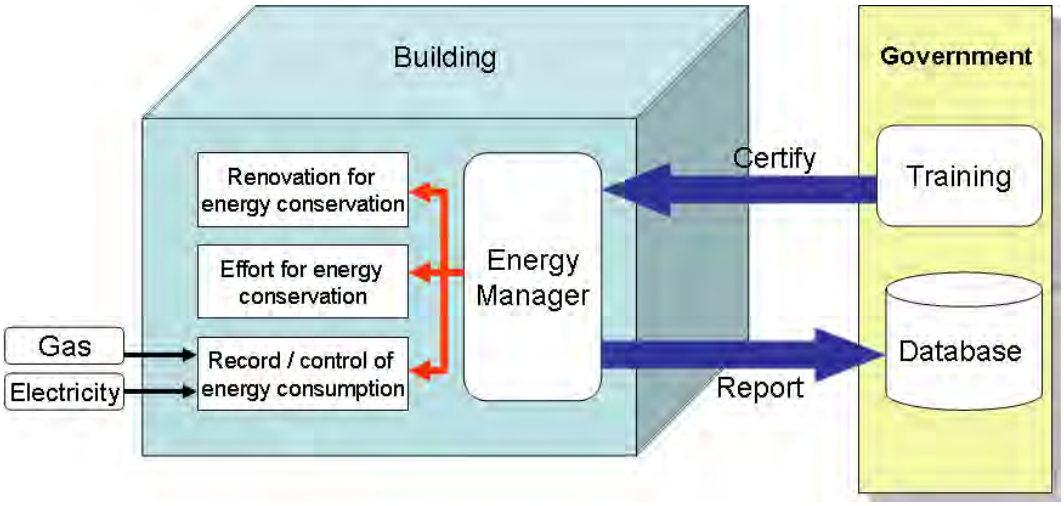


Figure A6-2 Positioning of the Database

Building a database indeed requires huge amount of work. Nevertheless, it is not enough just to build. It is important to maintain and manage the database (such as updating it every year), and use it in planning the policies and provide information for public. Here lists the concepts and enforcement methods for each of the following items.

- Building a database
- Maintaining a database
- Using a database
- Disclosure of a database and information

- 1) Building a database

In order to build a database, the following items must be defined.

- Purpose of building a database
- Data collection method
- Data items to be gathered
- Building a database

①Purpose of building a database

Types of information to be gathered about energy consumption of the buildings may vary according to the purpose of building a database. Gathering the detailed data will allow more information but cost more. It is very important to considering the cost and feasibility and to clarify the purpose of building a database.

Here, we assume the followings for the purpose of building a database on energy consumption of buildings in Iran. This may be changed depending on consideration by Iranian officials.

- To understand the actual condition and annual volume of energy consumption and CO2 submission of each building.
- To understand the actual condition and annual volume of energy consumption and CO2 submission of each building, by building use, size, and region.
- To understand the annual volume of (specific) energy consumption per unit area of each building.
- To understand the annual volume of (specific) energy consumption per unit area of each building, by building use, size, and region.
- To extract factors that influence energy consumption of each building and make effective use of formulating the energy conservation policy.
- To examine the effects of implementing the energy conservation policy.
- To supply the information of best-practice (benchmark) to ESCO Engineer and Award Program
- To understand the number of M&O and the capacity building program.

②Data collection method

For collecting building information, prepare a survey sheet to conduct the questionnaire survey on buildings.

In order to gather data on buildings as many as possible, it is important not to increase the number of data items to be gathered. It may be possible to conduct the survey and collect data exclusively within the city of Tehran at first, then expand the area to other cities in Iran after the second year. Limiting the survey to buildings with the total floor area of more than 1,000m3 or 5,000m3 may also be possible to consider.

As Tavaniri and NRI are conducting the basic research of 300 office building for labeling, it is effective to use these data.

Because the list of buildings does not currently exist, listing of the buildings to gather information must be done by the following methods step by step.

- Request local governments (Tehran City Office, etc.) to submit building information
- Obtain the list of buildings owned by governments
- Obtain the list of hotels, hospitals, etc. via the industry groups and/or the Internet.

③Data items to be gathered

On a survey sheet to be filled in, following data items must be included at the very least.

Information of a person filled in the survey sheet	・ Company name ・ Name of a person filled in the sheet ・ Contact information (Telephone number, E-mail address)
General information on the building	・ Building name ・ Building address ・ Completion year of the building ・ Site area, building area, total floor area, number of floors (below ground, above ground)
Information on the purpose of usage of the building	・ Area ratio according to the purpose of usage of the building
Information regarding the energy consumption volume	・ Annual energy consumption volume (by month) ・ Annual gas consumption volume (by month) ・ Annual energy consumption other than those above, such as LPG, fuel oil, etc. (by month)
Information regarding the energy conservation activities	・ Energy conservation policies implemented in the past year ・ Energy conservation policies planning to implement in the future

Other than listed above, it is preferred to review the data items to be surveyed in order to get more detailed information on building utilities, such as the capacity of access to electricity, cooling and heating system/equipment/operating condition, etc.

④Building a database

To register the data gathered from survey sheets in the database as electronic data, it is necessary to check the specified contents on each survey sheet. In a case where incompletion or mistake is found, such data must be corrected by contacting a person who filled in the survey sheet. For building a database, only the correct, confirmed data should be entered in the database.

2) Maintaining a database

Once the database is built, however, it does not make any sense unless the database is properly maintained.

Accumulation of data gathered through continual annual surveys enables more effective analysis. If adding survey data items or expanding the area of survey after the second year, it is important to expand the database while assuring the sustainability of the existing database. Conducting the system maintenance or backup of the server, where database is stored, is also required.

For those activities, it is required to establish the database maintenance system to be conducted under the appointed person in charge of administering.

Currently in Iran, electricity is administered by the Ministry of Energy, while petroleum/gas is administered by the Ministry of Petroleum, and as the energy conservation authorities, SABA and IFCO are established under the respective ministries. Because the electricity and petroleum/gas are used as a source of energy for a building, both energy sources should be treated at once. For example, establishing the new energy conservation center, as a responsible authority for energy conservation in Iran, may be a good idea in order to promote and implement the building and maintaining the energy database.

3) Using a database

The utilization of the developed database will help in understanding the current situations or in conducting various analyses. Then, those results of analyses will help in creating fundamental data for planning energy conservation policies.

The followings are the examples of database utilization:

Obtaining information on actual conditions	・ To understand the distribution condition by size/purpose of usage of teach building ・ To understand the energy consumption, etc. of each building
Understanding and utilizing mean-value	・ To understand the average of specific energy consumption of each building ・ To understand the changes in specific energy consumption of each building (To understand the implementation status of energy conservation policies) ・ To evaluate the efficiency of energy consumption of each building
Analyzing a data	・ To forecast future specific energy consumption volume of each building ・ To predict the effects of energy conservation policies ・ To establish the standard values of the energy conservation labeling system ・ To establish the energy conservation goals, etc.

4) Disclosure of a database

In addition to the utilization within the government institutions, open disclosure of the developed database will enable more effective use of the database.

For example, the disclosed database can be used at universities or research institutes for conducting researches or simulations in the fields of energy conservation or energy economy. It can also be useful at private-sector firms when developing and selling the energy-saving products, setting the energy conservation goals, etc.

However, there are two points to keep in mind when disclosing the database.

The first is to protect the anonymity. Because the registered data in the database contains information on individual buildings, consideration is required for not creating any disadvantages to the data providers. In particular, it is important not to disclose the building information that can specify the address, name, site area, number of years from the construction, etc. This may be solved by providing each building with ID number and disclosing the information by numbers, or by disclosing the overall values only.

Another point to keep in mind is to develop an access method for the disclosure. In particular, it is necessary to establish rules for the disclosure, such as development of web design, authorization of access, response to inquiries, etc., and then to implement the disclosure based on these rules.

5) Information transmission

One of the most important ways of promoting energy conservation in Iran is to widely transmit information regarding current conditions of energy consumption or improvement plans for energy consumption effects of buildings, best-practice and increase awareness of energy conservation promotion.

On this occasion, utilization of data from a database in creating compiled data or secular changes or in introducing best practices can be useful for increasing awareness of energy conservation of buildings in Iran.

The following diagram shows the flow of building and utilizing a database as stated above.

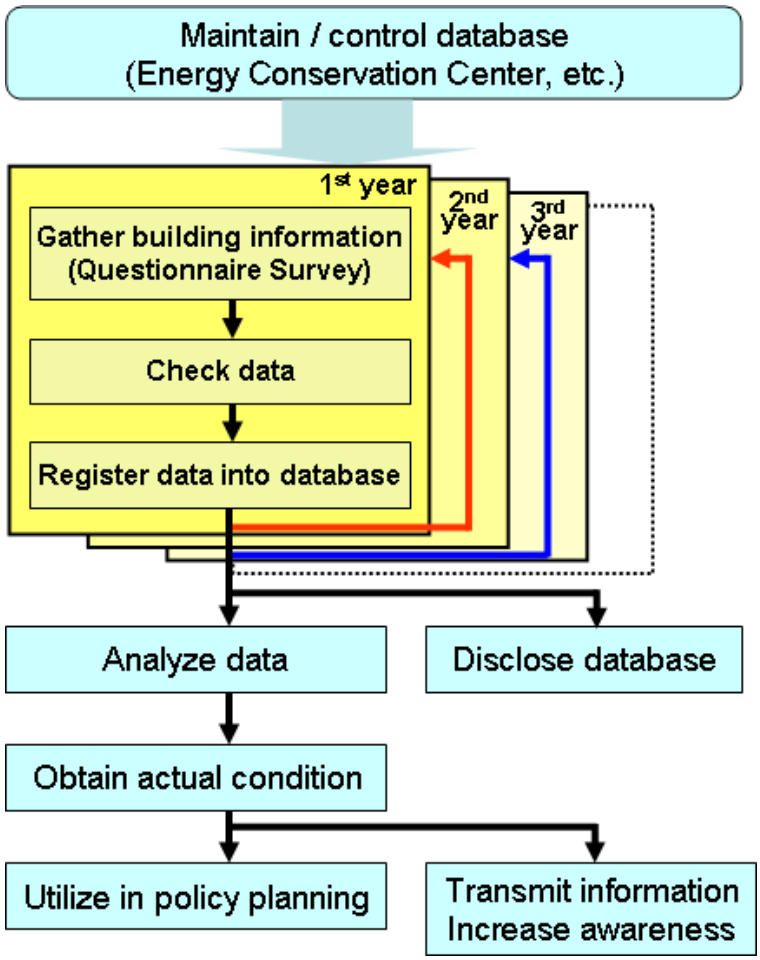


Figure A6-3 Flow of building and utilizing a database

6) Expanding a database

So far, we have intended the system that enables various counting and analysis by continually gathering information on buildings and energy consumption in Iran and storing and managing data in an integrated fashion as a database. Also, we have shown the method of utilizing a database, as well as the ideas and procedures for building such database.

The most important thing as a database for promoting energy conservation of buildings is to gather a wide variety of information of each building and to maintain it easy-to-use. Other than that, a properly-maintained database enables storing and sorting various data in a way that is easy-to-extract when needed.

Based on this perspective, other than the data related to buildings we stated earlier, it is desirable to build a database that, for example, stores and compiles the following type of data and is freely available when needed (see diagram below).

- Database consolidating outcomes of the energy conservation diagnosis conducted by institutions such as SABA, IFCO, etc.
- Database of ESCO enterprises within Iran
- Database regarding the energy conservation technology of buildings, etc.

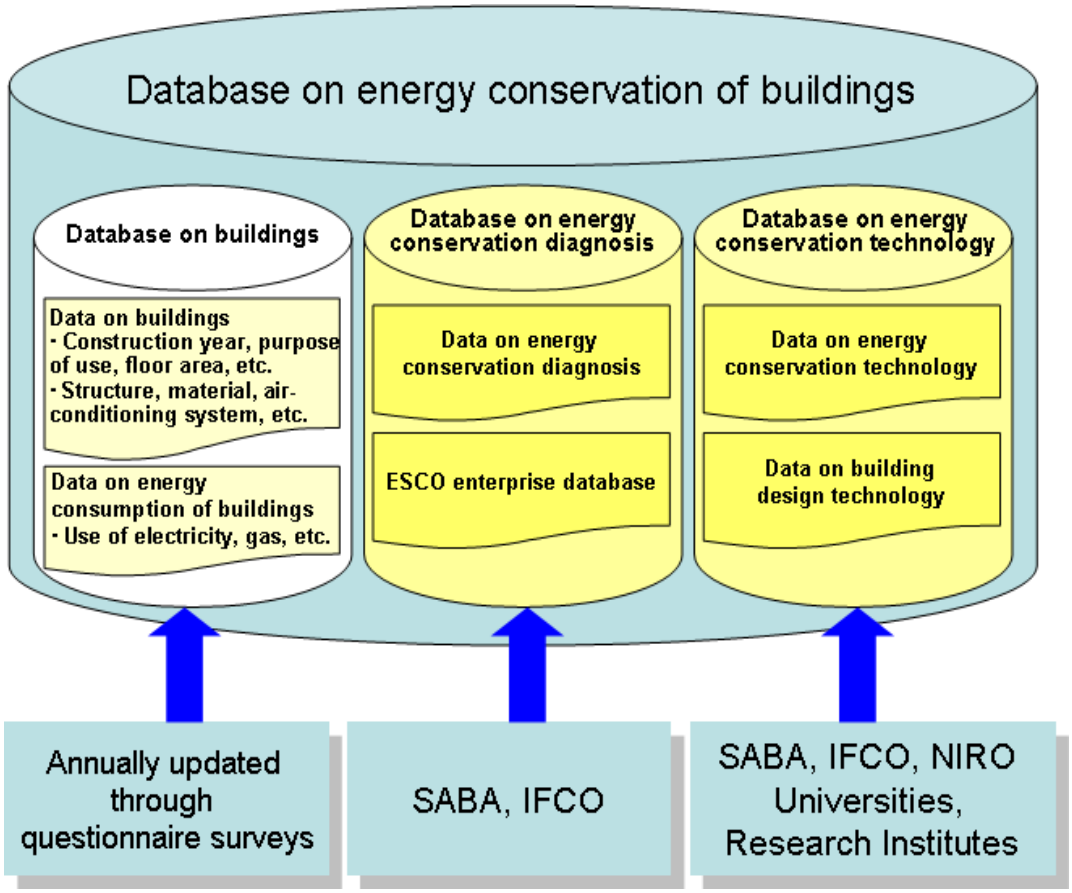


Figure A6-5 Image of the expanded database

Summary of Development of a Database Action Plan (Draft)

1. Name of the Program	Development of a Database (Database of building information)
2. Implementing Agencies	SABA and/or IFCO (or the new energy conservation center to be established)
3. Target	1) Energy managers of the buildings 2) Building managers, building owners 3)ESCO Engineer
4. Objective	To continually collect basic data and energy consumption data of the buildings, and to maintain as a database.
5. Expected Effect	・To obtain the actual situations of energy consumption of buildings and bench-marking data. ・To utilize the basic data in planning policies related to energy conservation for buildings.
6. Estimated Cost	About $3 million / year
7. Implementation Period	First Phase (2012～2013), Second Phase (2014～2016)

8. Contents of Implementation

First Phase (2012～2013)

This Program is designed to establish a system to acquire data on basic building information, building structure, and energy consumption of each building, to actually conduct the questionnaire survey for every building in the City of Tehran and acquire these data, and to build a database.

The necessary preparation for building a database is made in the first year, and actual implementation of data acquisition and building of a database is made in the second year.

1) 1st year (Component 1): Preparation for building a database

- ✓ Consider the type of database to build and design the database.
- ✓ Prepare the survey sheet to conduct questionnaire survey to all buildings in the City of Tehran.
- ✓ Prepare the list of buildings in the City of Tehran (the list of addresses for delivering the survey sheets). To accomplish this, gain the cooperation from the City of Tehran and consider acquiring the list of other buildings.
- ✓ In light of the above, conduct questionnaire survey to the buildings and prepare the plan for building a database on building information in the second year.

2) 2nd year (Component 2): Acquiring data and building a database

- ✓ Based on the plan developed in the first year, conduct questionnaire survey to the buildings.
- ✓ Collect the answered survey sheets, check data, confirm any insufficient data, and correct.
- ✓ Store the building-related data gathered via surveys into the developed database system.
- ✓ Check the data is properly stored into a database system.
- ✓ By utilizing the database system, figure out the sum total, average, or energy consumption volume by purpose of use or size of each building.

Second Phase (2014～2016)

- ✓ Continue the First Phase.
- ✓ Expand the area of survey from the City of Tehran to other major cities.
- ✓ Based on the experiences obtained from the First Phase, improve the data collection method and database.
- ✓ Based on the accumulated data, implement the data analysis.

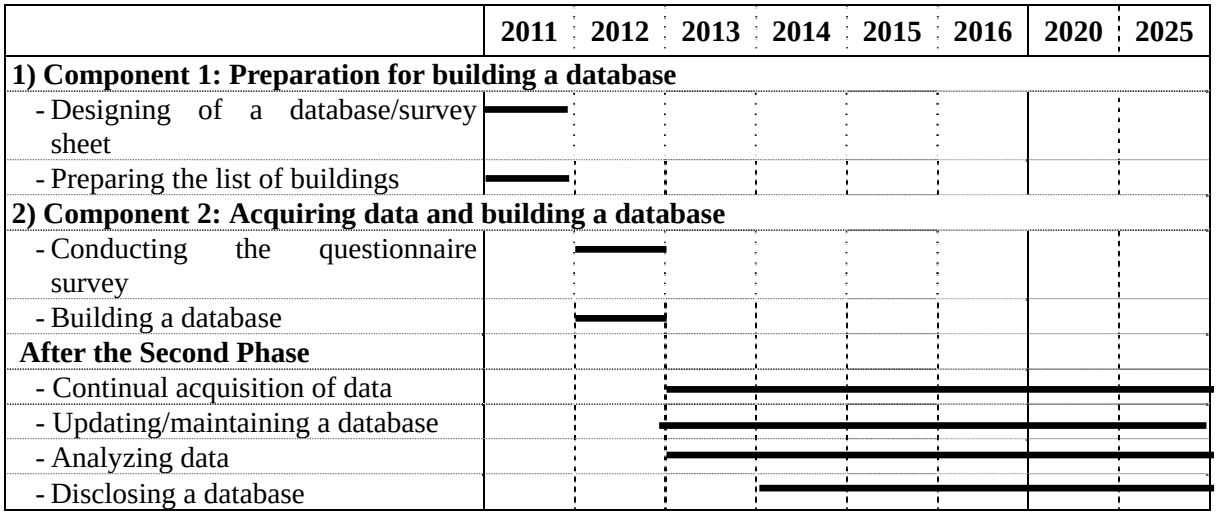
9. Implementation Challenges

- ✓ The area of buildings for questionnaire survey must be considered. Conduct buildings in the City of Tehran in the First Phase, and expand the survey area to the buildings in other big cities in the Second Phase. It is also desirable not to target all building sizes but limit to large-scale buildings to some extent (for example, total floor area of more than 5,000m3). Anyhow, it is important to consider the range of building sizes to be surveyed.
- ✓ Some buildings may not have recorded data on energy consumption. Therefore, it is necessary to request building managers/owners to record data on energy consumption in advance to the survey.
- ✓ Selection of the survey data items is also very important. Although it is desirable to acquire detailed information, it is important to create an appropriate questionnaire sheet in order to avoid the cumbersome/complicated answers that can lead to the low response rate.

10. Necessity of Technological Support

- ✓ Acquisition of the data on energy consumption of buildings through conducting the questionnaire survey is the first attempt in Iran. For this reason, it is important to receive a support by some professional person with similar experience in collecting data on energy consumption of buildings.

Implementation Schedule



Budget

(Unit: Million US$)

	2011	2012	2013	2014	2015	2016	2020	2025
1) Component 1: Preparation for building a database								
- Designing of a database/survey sheet	1.0							
- Preparing the list of buildings								
2) Component 2: Acquiring data and building a database								
- Conducting the questionnaire survey		3.0						
- Building a database								
After the Second Phase								
- Continual acquisition of data			3.0	3.0	3.0	3.0	3.0	3.0
- Updating/maintaining a database								
- Analyzing data								
- Disclosing a database								
Total								

Annex 7 Establishment of Financing Instrument for ESCO Business

In current Iranian architectural education system Tehran University provides the only B.A. and M.A. course of "Architecture and Energy" in its faculty of architecture. This "Architecture and Energy" course will become in the near future a M.A. and Ph.D. course of an independent graduate school, which treat with building design and energy design in a comprehensive approach. Tehran University provides a course about "Architecture and Energy" at undergraduate level to this intent, whereas other universities in Iran do not in current situation. It is important that those who not specialized in environmental engineering or mechanical design in architecture (in other words,those specialized in building design, urban design, structural design and so on), possess basic knowledge on relation between architecture and energy, in order to promote EE&C technology promotion in architecture. One of objectives of Tehran University's "Architecture and Energy" course is that Ph.D. holders from this course will create "Architecture and Energy" course at faculty of architecture of other universities across Iran and teach there. Though this plan is expected to allow many graduates from faculty of architecture to acquire basic knowledge on relation between architecture and energy, it requires an extended period of time. Therefore, an reinforcement of education program of energy saving design in existing architecture higher education is desirable.

Currently, Iranian architecture higher education institutions use Farsi translation of *Neufeld* as reference book of design training class, which is edited in Germany and widely used for architectural education in western countries. In general, such design reference book is edited in each country, offering vast reference items of architectural design, going from basic building planning, building method, structure, module, material, through environmental planning, mechanical planing, to design method according to building types and examples. For this reason, this kind of design reference book is also referred as a design handbook for practical design work after graduation. However, as Iranian climate, construction technology and cultural custom differs much from wester countries, it would be difficult to promote design and building method appropriate for Iranian climate, by means of learning design with a reference based on western standard as well as applying it to practical design work. Therefore, it would be desirable that a design reference book would be edited mainly by people related to building research, architectural education and practical design, which synthesizing as standard building design specification, items such as building related law in Iran, building method conform to EE&C standard, structure, module, material, as well as environmental planning, mechanical planing, and design method according to building types and examples, usable both as architectural education and practical design handbook. Furthermore, in terms of improvement of construction technology and quality control, it would be also desirable to edit a handbook synthesizing standard construction specifications, which are usable for both design and construction. By standardizing divers types of construction specification, including low energy consuming buildings, thermal performance of not only low energy consuming buildings, but also building in general will be

enhanced and improvement in energy efficiency of buildings across the country will be expected as a result.

In terms of promotion of building technology related to EE&C, creation of a clearinghouse would be expected. The objective of this clearinghouse is to collect information about EE&C in architecture, and release it to consumers (design and construction clients) and technicians (designers). If the unification of information to this clearinghouse allows consumers and technicians to obtain necessary information by accessing to the clearinghouse, diffusion of information related to architecture toward consumers and technicians interested in EE&C of buildings would be promoted. Information to be collected and released would comprise basic information on design and construction of low energy consuming building, information on building material, equipment and home appliance conform to EE&C standard, information on designer and constructor capable of EE&C building design and construction, information on EE&C related companies such as ESCO, as well as labeling and prizes for EE&C related technologies (building, building material, equipment, home appliance). Moreover, although a clearinghouse is an information releasing system and not necessarily a releasing facility, in case a clearinghouse facility is created, making the facility energy efficient will appeal to consumers and technicians visiting the facility as the facility would attract attention of those consumers and technicians.

The points above imply following measures as Action Plan, so as to promote EE&C related building technology in Iran.

(1) Establishment of standard design specification and standard construction specification

Promotion of design technology and improvement in construction technology and quality control are indispensable for EE&C promotion of buildings in Iran. For this purpose, a standard specification conform to climate, building related law, EE&C standard and construction technology, which can serve as design and construction reference handbook for designers, constructors and students in architecture shall be established. By reference to current situation in Iran and examples of other countries, this standard specification shall be edited mainly by Iranian people related to building research, architectural education, practical design and construction technicians.

・Editing standard design specification

To edit a design reference book, which organizes systematically building related law, building method conform to EE&C standard, structure, module, material, as well as environmental planning, mechanical planning, and design method according to building types and examples, usable both as architectural education and practical design handbook.

・Editing standard construction specification

To edit a building construction reference book, which organizes systematically execution procedure of each construction method, quality control standard and its procedure, safety control standard and its procedure, specifications of building material, specification of building equipment, module of building materials (e.g. steel stock, makeshift materials) and equipment materials (e.g. sanitary ware, plumbing), usable as practical design and construction supervision.

(2) Improvement of educational program for EE&C building design in existing faculties of architecture

In existing faculty of architecture in Iranian universities except for Tehran University, do not provide a class or a courses with a comprehensive approach to building design and energy planning. Though, as mentioned above, Tehran University project to create a Ph.D. course of "Architecture and Energy" course, whose graduate students will be expected to teach building design and energy planning with a comprehensive approach at faculty of architecture of other universities across Iran, this project will require an extended period of time. For this purpose, educational program for EE&C building design in existing faculties of architecture in Iran shall be improved.

・Holding a special lecture on EE&C building design

To hold a short period or one-shot special lecture for all students in order to diffuse basic knowledge on building design and energy planning as well as to rouse their interest in EE&C building design. Faculty teacher and researcher involved in education and research on architecture and energy, building environmental engineering, and EE&C building design shall take charge of the course.

・Creation of credit exchange program among subjects related to EE&C building design

To create credit exchange program for students of a faculty of architecture without a class about EE&C design, which enables them to participate in a specific class on EE&C design in another faculty of architecture, as well as to include the credit of this class to needed credit for graduation.

・Creation and opening classes related EE&C building design

To create classes and a course about EE&C building design at faculties of architecture, as soon as they can secure adequate personnel to direct building design and energy planning in a comprehensive manner, such as Ph.D. holders from "Architecture and Energy" course of Tehran University, as well as those who had experience in teaching EE&C building design in a foreign country. At the opening of a class or a course of EE&C building design at a faculty, this faculty shall

open the class to its neighboring faculties of architectures which have not opened their class of EE&C building design by establishing credit exchange program.

(3) Creation of a clearinghouse

An integrated information releasing system is necessary in order to diffuse architectural technology related to promote EE&C of buildings. For this purpose, a clearinghouse that is a system to collect EE&C related information of buildings and release it toward consumer (building owner) and technician (constructor).

・Examples of EE&C related information of buildings collected and released by a clearinghouse

Basic information about design and construction of EE&C buildings / iInformation on building material, equipment and hope appliance conform to EE&C standard / information on designer and constructor capable of EE&C building design and construction / information on EE&C related companies such as ESCO, / labeling and prizes for EE&C related technologies (building, building material, equipment, home appliance)

Annex 8 Establishment of Financing Instrument for ESCO Business

In Iran, the type of ESCO business with a performance-based contract to promise a fix result of benefit for the client has so far not yet appeared. The major reason for this can be attributed to the fact that the instrument of project finance is still undeveloped so that it is impossible for the ESCO companies to secure a long-term loan at low interest rate needed for an ESCO project. At present, financial institutions extend loans only at high interest rate and in short-term, while the problem of possible credit risk on the part of the ESCO companies or end-users of energy may also be the barrier for their access to favorable funding. In the light of this, what we would like to propose as a special financial mechanism which is meant to make it possible for ESCO business to play a decisive role in promoting EE&C in the Building sector should be one with the possibility of proving long-term loans at low interest rate and meanwhile taking part of the risk associate with this type of business. In other words, the financial mechanism for ESCO should essentially equipped with two qualities, one is the quality of being able to provide a sum of initial capital sufficient to meet the need of long-term loans at low interest rate, and the other is that of risk-taking by public sector to a certain extent. With the establishment of this type of financial mechanism, it becomes possible that, on the one hand, the banks can extend long-term loans at low interest rate to the ESCO companies without worrying about the issue of capital burden, and on the other hand, the government is ready to share the risk associated with ESCO business to a certain degree. It is only with the availability of these two kinds of support extended by the public sector that the banks were willing to actively participate in the ESCO business and thus the government' s policy intended for EE&C promotion could be expected to be carried out..

Based on this argument, the Study Team would like to propose a paradigm of risk sharing, as illustrated below, with regard to the financial mechanism designed to promote EE&C in Iran

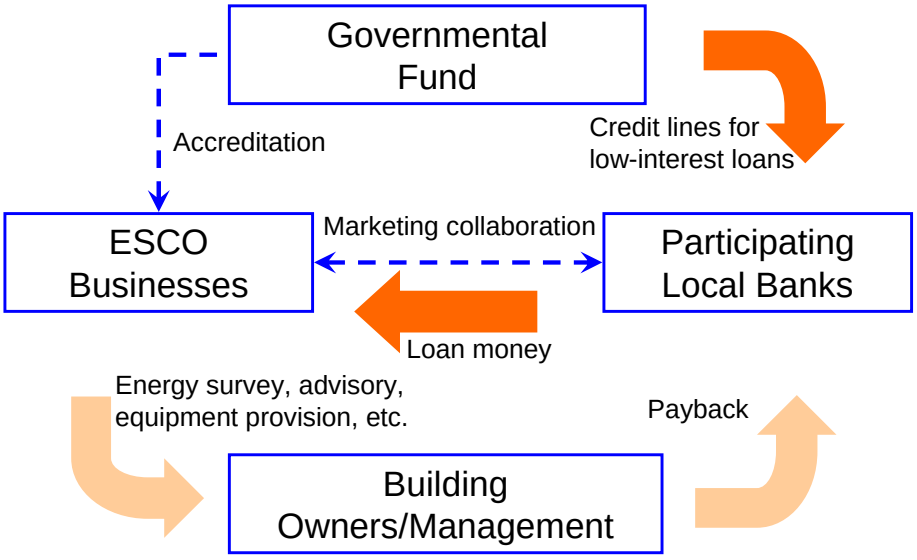


Figure A8-1 Prototype Financial Mechanisms for EE&C Service by ESCOs in Iran

However, the government should create credit lines with clearly stipulated purpose and formulate

clear and transparent operational guidelines and manuals so as to make it possible for the financial mechanism to be operated. In other words, in order to ensure fair operation of the credit lines, it is necessary that the operational guidelines and manuals be disclosed to the public. Specifically, the following technical components of the financial mechanism need to be prepared and publicized:

- Operational manual of the credit lines
- ESCO accreditation operational regulations and accreditation criteria
- Payback scheme
- Third party verification mechanism

In light of the above-mentioned, we would like to propose the following action plan with the view to promoting participation of banks in the ESCO business.

- Program for the Formulation of Special Financial Mechanism for ESCO

Summary of Formulation of Special Financial Mechanism Action Plan (Draft)

1. Name of the Program	Formulation of Special Financial Mechanism (SFM) for ESCO
2. Implementing Agencies	MoE
3. Target	1) Concerned officials of MoE、MEAF and Central Bank（Regarding financial support for ESCO business） 2) All the bank managers in Iran
4. Objective	Participation of Banks in the ESCO business is realized.
5. Expected Effect	1) Government and banks share their understanding of the importance of ESCO business. 2) The SFM extending long-term loan at low interest rate to ESCO business is established. 3) The number of banks extending loan to ESCO business substantially increases.
6. Estimated Cost	1st Phase: $600,000 for the 1st year and $400,000 for each year after the 2nd Year. 2nd Phase:
7. Implementation Period	1st Phase : 2012-2015 2nd Phase: 2016-

8. Contents of Implementation:

This program consists of on-the-job training (OJT) focused on the issues of ESCO business and SFM with officials of government agencies relevant to financial support for ESCO business (MoE, MEAF and the Central Bank) and all the bank managers in Iran as intended audience, field study on the current situation of bank's participation in ESCO business and existing problems, designing, document drafting and trial operation of SFM for ESCO business, as well as holding of workshops.

1st Phase: (2012-2015）

[Program for Year 2012]

1) Enlightenment Activities Regarding Financial Support for ESCO Business

- ✓ Aiming at the audience's awareness of the importance of ESCO business as well as the roles of government and financial institutes in it, learning of experiences and lessons from foreign countries (regarding practices of shared saving and guaranteed saving), and understanding of current situation of ESCO business and existing problems in Iran.
- ✓ Dispatching a short-term Japanese expert to give lectures and to facilitate discussions on the above-mentioned topics through a three-day training course.

2) Field Study on the Current Situation, problems and Countermeasures

- ✓ A field study on the current situation and problems regarding bank's participation in ESCO business to be conducted by Japanese short-term experts with the help of Iranian counterpart (C/P)
- ✓ Rendering the results of field study into a report with recommendations regarding relevant countermeasures taken by the government and other stakeholders

3) Holding of Workshop

- ✓ Giving Presentations of the results of OJT and field study conducted so far
- ✓ Exchange of ideas regarding financial support for ESCO business among government officials, Bank managers and ESCO company managers

4) Designing and Document Drafting of SFM for ESCO Business

- ✓ Designing SFM for ESCO business and drafting the related documents through cooperation between experts from Japan and Iran, based on experience of Japan and the other developed countries and the reality of Iran. The related documents consist of :
  - ➢ Operational manual of the credit lines

- ESCO accreditation operational regulations and accreditation criteria
- Payback scheme
- Third party verification mechanism

✓ Submitting the draft documents concerning SFM for ESCO business to the Iranian government.

[One year program for 2013, 2014 and 2015]: Trial operation of SFM in Teheran City

1) OJT Aiming at Understanding and Application of the Financial Mechanism（on the premise of approval by the Iranian government）

✓ Conducting the OJT focused on the above-mentioned four topics through a five-day training course

✓ Intended audience to be the bank managers as well as ESCO company managers

2) Start of Trial Operation in the Financial Mechanism

✓ Designation of ESCO accreditation institution

✓ Start of accepting application for accreditation from ESCO companies and trial operation of the accreditation system

✓ Start of trial operation in the other relevant systems

3) Holding of Workshop

✓ Review on the results of OJT having conducted so far and the existing problems

✓ Review on the performance of the ESCO accreditation system and the existing problems so far

✓ Review on the performance of the other systems relevant to SFM for ESCO business

✓ Sorting out the all the existing problems and submitting the recommendations regarding necessary countermeasures to the Iranian government

2nd Phase: (2016-): Extension of SFM application to the whole country by Iranian side

9. Implementation Challenges

✓ The implementation of t the component to be started from 2013 will not be viable without approval from the Iranian government regarding the Proposed SFM. Accordingly, discussion with the concerned government agency need to be held beforehand to make sure of the perspective for the proposed SFM to be approved by the government

10. Necessity of Technological Support

✓ Although technical assistance would not be needed in the implementation of this program, it is possible for Japan to extend assistance by applying its relevant experience to Iran. Therefore, it would be appropriate to execute this program through cooperation between the dispatched short-term Japanese experts (or consultants) and the Iranian C/P.

Implementation Schedule

	2012	2013	2014	2015	2016	備考
-Enlightenment Activities Regarding Financial Support for ESCO Business						
- Field Study on the Current Situation, problems and Countermeasures						
- Holding of Workshop						
- Designing and Document Drafting of SFM for ESCO Business						
- OJT Aiming at Understanding and Application of SFM						
- Start of Trial Operation of SFM						
- Holding of Workshop						

Budget

(Unit: Million US$)

	2011	2012	2013	2014	2015	2016	2020	2025
1st Phase								
-Enlightenment Activities Regarding Financial Support for ESCO Business	0.1							
- Field Study on the Current Situation, problems and Countermeasures	0.1							
- Holding of Workshop	0.1							
- Designing and Document Drafting of SFM for ESCO Business	0.3							
- OJT Aiming at Understanding and Application of the Financial Mechanism		0.2	0.2	0.2	0.2			
- Start of Trial Operation in the Financial Mechanism		0.1	0.1	0.1	0.1			
- Holding of Workshop		0.1	0.1	0.1	0.1			
Total								

Annex 9 Establishment of the Training Center for EE&C for the Building Sector

EE&C for the building sector requires human resources development targeting diverse trainees along with project cycle of planning, designing, construction, supervision, inspection, and commissioning of building. When a building project completes, a variety of professionals concerning operation, maintenance, regular check-up, repair, renovation, etc need to work collaboratively and closely. Unlike the manufacturing sector, any architectural projects are built to order in nature. The building are always exposed to uncontrollable environment during production, therefore promotion of EE&C for the building sector need to consider complex factors. In addition, the buildings continue to expose to the weather so long as its life cycle. Materials and equipment used for a building are industrially manufactured products and are to perform EE&C contributions to whole buildings. They are assembled with a millions of combination with a variety of element technologies available in Iran. Another characteristics and challenges of EE&C for the building sector is that the favorable EE&C performance are not guaranteed by pulling these materials together because it requires meticulous building techniques, installation, operation and maintenance. The total energy consumption necessary for operation and maintenance after the completion is twice as much as bigger than those required for manufacturing of materials and construction combined. The proposed training center for the building sector is designed to provide EE&C training for a variety of stakeholders. The center will be the venue to extend the most advanced and up-to-date EE&C technology in Iran.

Summary of Human Resourced Development Action Plan (Draft)

1. Title	Human Resources Development Action Plan for Promoting EE'C for the Building Sector
2. Implementing Agencies	MOE is responsible for overall coordination of implementation of the Action Plan. Ministerial divisions and affiliated agencies as well as other ministries including MOE/OIPEEE, old MOHUD and MOP are implementing organizations for the plan. The private sector needs to take part to carry out various activities listed in the plan.
3. Target of Capacity Development	Initial target of the plan will be the following: 1) Architects and engineers (architects, construction, HVAC, and electric engineers), and officers of government (central and municipal) 2)The private sector which provides energy related services (ESCO businesses) 3) Financial institutions 4) Building owners who operate and maintain the building as asset ESCO
4. Goal	Improvement of energy intensity of the building sector in Iran
5. Expected Outcomes	Human resources development of core personnel to promote EE&C for the building sector in Iran
6. Budget	
7. Implementing Period	Phase 1 (2012 to 2014), Phase 2 (2015 to 2016)

8. Description of the Plan

(1) Strategy for Human Resources Development

The basic approach of the action plan is to train core personnel for promoting EE&C in the building sector. To do so, the following strategy is defined to both new and existing building.

・**Basic Strategy 1 (New Building):** Capacity development to apply and adopt the Article 19 of the Building Code of Iran, and

・**Basic Strategy 2 (New Building):** Establishment of market-driven ESCO business in Iran.

(2) Subcomponents

The action plan consists of two strategies of new and existing buildings and implements both simultaneously. The plan is made up with the following strategies and defines target with a given project period. On each component, respective targets of capacity development are defined. Implementation of the capacity development is phase-wise based on the target and objective of each phase. (Items listed in the action plan are selection from the priority program, corresponding project number is indicated.)

1) Sub-component for New Building (Expected Output)

1-1 Practical training for enhancing EE&C technology for the building sector (Priority Program #8, 9 and 10)

- ✓ Enhancement of capacity in such area as plan, design, examination, construction, supervision, inspection and commissioning (tuning upon completion) for envelops, HVAC, electric systems, etc.)
- ✓ Iranian side is particularly interested in establishment of "EE&C Training Center for Architecture" as the national center for all parties concerning the building sector. The center provides adequate training facilities in variety of training from building construction (plan design, construction, etc). The training center would like to own its own facility to maximize impact by providing any possible learning experiences including unrealistic control of operational parameters which would not allowed in the real operation.
- ✓ OJT will be provided throughout all process of the construction including very scratch of initial planning to commissioning. Trainees will have experienced all aspect of construction through on-going process of development of the proposed training center. The training will be

experiencial and aims at training of trainers.

1-2 Establishment of Clearinghouse for publishing information on EE&C technologies (Priority Program #8)

- ✓ As an organization exclusively collects the related information, the proposed clearinghouse collects and publishes a variety of technical information such as machinery, equipment, materials and building methodologies). The information collected is to be provided from the one source to businesses (building owners, architects, engineers and construction companies). So called one-stop service helps to gather useful information in one place and enabling promoting EE&C.

1-3 Strengthening of awareness for the needs of the building sector targeting to the owners of the building and developers. (Priority Program #6)

- ✓ Introduction of good practices of technologies and feasibility study on EE&C in Iran. These advanced technologies and examples are to be published to promote and accepted EE&C widely ヒ The training shall designed for business person without technical training. It should be provided in the proposed training center.

2) Sub-component for Existing Building (Expected Output)

2-1 Training to Enhance of technical capacity for EE&C for the building sector enabling to provide energy audit and analysis. (Priority Program #5)

- ✓ Provision of specific training to ESCO businesses and other EE&C related services providers to enhance capacity for energy audit, analysis, recommendation for renovation, and operation and maintenance, etc

2-2 Development of financial frameworks for supporting EE&C (Priority Program #15)

- ✓ Human resources development enabling for a vital financial mechanism to support EE&C financially. The focus of the training includes skills and knowledge in feasibility study and analysis, preparation of project documents, etc.

2-3 Establishment of the procedures for ESCO business schematics (Priority Program #5)

- ✓ Furnishing a variety of standard contractual formats including performance-based agreement, etc. Identification of a various issues on business and contractual environment in Iran for promoting EE&C business.

2-4 Establishment of ESCO Business Association

- ✓ Establishment of an industry association to promote ESCO business model by creating the market. The association represents common benefit of ESCO businesses.

2-5 Strengthening of awareness for the needs of the building sector (Priority Program # 5 and 6)

- ✓ (As same as the new building program No. 1.3), dissemination of various information related to EE&C technologies targeting the owners of the building, developers, head of municipalities, etc. The training provides good practices found in Iran to promote the idea and awareness of necessity of adopting EE&C. Through such activities, the newly developed and constructed building project shall adopt the new technology.
- ✓ Providing one-day long audit (preliminary on-site audit) funded by the government makes owners of building, etc. aware of importance of promoting EE&C in their own building as well as energy-saving potentials. The audit activity may propose and recommend possible renovation and improvement of operation, etc. leading expansion of EE&C market in the long run.

Phase 1 (2010 to 2014)

1) Selected Activities for Promoting EE&C to New Building

1-1 Practical training for enhancing EE&C technology for the building sector (Priority

Program #8, 9 and 10)

- ✓ By inviting stakeholders (i. e. instructors, administrators, designers, university scholars, EE&C policy maker, etc.) specifications and requirement of the proposed training center (e.g. number of participants, necessity of accommodation function, number of seminar rooms, size of building, contents of training, facility, necessary equipment, etc.) is identified.
- ✓ To identify EE&C technology, etc readily available in Iran. Collect relevant information on appropriate EE&C technology in Iran.
- ✓ Design the facility (envelopes, HVAC, facilities, etc.) based on the basic specification identified.
- ✓ Prepare design documents for building permit and specification for procurement
- ✓ Carry out application procedures. Support, if necessary, municipal government through the Engineering Association for procedures for building permits.
- ✓ Carry out procurement (Bidding announcement, selection, budgeting, contracting, etc.) following the local rules.
- ✓ Land braking. Assist Iranian side supervision and construction management.
- ✓ Conduct, as necessary, a variety of inspections (e.g. material, excavating, metal and steel bars and beams in factory, forms, concrete, curing, etc.).
- ✓ Internal inspection based on the documents approved. (Utilizing plans, photos during the construction, etc.) and inspection by government.
- ✓ Receipt of certification of final inspection and keys.
- ✓ Post-completion commissioning by commissioning engineers (opportunity for OJT for EE&C engineers.)

1-2 Establishment of Clearinghouse for publishing information on EE&C technologies (Priority Program #8)

- ✓ Identify the specification and types of information to be collected (kind of information and technology, methodology of data collection, publication, etc.)
- ✓ Deciding necessary functions to be included in the proposed clearinghouse. Estimate human resources and necessary equipment, etc.
- ✓ Ensure the facility according to the specifications and requirements above. (If the space is to be built new, procure architects to design the facility based on the specifications. Procure contractors to build the facility, according to the rules and regulation of procurement in Iran.)
- ✓ Collect new technology (equipment, building materials, ESCO business and contact, EE&C services providers, EE&C approaches, etc.)
- ✓ Publish the information to public.
- ✓ Review and renew the information.
- ✓ If necessary, the chronology of construction of the new training center (1-1) is systematically collected and published.

1-3 Strengthening of awareness for the needs of the building sector targeting to the owners of the building and developers. (Priority Program #6)

- ✓ Decide the targets (Initially the owners of large building, developer, head and administrators of municipalities, etc.)
- ✓ Plan and design training and seminar according to the targets.
- ✓ Introduce EE&C technology, good practices (in terms of financial and technological effectiveness). These examples may be a good lead for adopting new technology to the new development. The target may be business person with no technical background and training, the contents of the training shall be specifically designed to these targets.
- ✓ As consistent to “2-5 Strengthening of awareness for the needs of the building sector”, the target and the contents are common. Both training shall be examined and reviewed to avoid duplication. (There is a possibility that the owners of new and existing building are the same. Therefore the contents of the training may be shared by both types of target, etc.)

2) Activities for Promoting EE&C for the Existing Building

2-1 Training to Enhance of technical capacity for EE&C for the building sector enabling to provide energy audit and analysis. (Priority Program #5)

- ✓ Until the proposed training center completes, OJT using existing building nearby shall be used.
- ✓ Training on audit activities (measuring, analysis, recommendation, implementation of renovation, etc) as well as management capacity shall be carried out.

2-2 Development of financial frameworks for supporting EE&C (Priority Program #15)

- ✓ Training targeting financial institutions to enhance the understanding on ESCO businesses may be carried out. Initially the training shall be concentrated on promoting ESCO business as a promising business model. Later, the training shall focus on financial framework to support ESCO business.
- ✓ Study good practices elsewhere (may be in Japan, Europe, etc.) on financial mechanisms to support EE&C. F/S, project appraisal, preparation of project document, etc. are essential skill to promote the business.
- ✓ Introduction of subsidies through low-interest loan for promotion of ESCO via public finance or grant aid from international donors. In the latter period, the government will provide loan guarantees to support finance from regular financial institutions

2-3 Establishment of the procedures for ESCO business schematics (Priority Program #5)

- ✓ Establishment of ESCO Business Association and prepare manuals for ESCO business including a prototype of agreement.
- ✓ Through the pilot project defined in 2-4, review the validity of newly developed guidelines and agreement.

2-4 Establishment of ESCO Business Association

- ✓ Establish and organize an independent ESCO Association and register ESCO business entities. (Initially, the registration criteria may be based on type of business, financial standing, business record, number of able engineers, etc may be the prospective criteria in the future).
- ✓ Establish a link to ESCO Associations overseas and share relevant information among the members
- ✓ Pilot audit activities shall be carried out to promote ESCO business mode and promote promising ESCO projects. Audit of the public building should be carried out immediately. If they are promising, model ESCO project should be carried out. The result shall be reviewed and disseminated to financial institutions as explained 2-2, and taught as the contents of training for owners and developers in 2-5. In addition, it shall be promoted to general public for publicity.
- ✓ Introduction of ESCO business model to public building may have some obstacles because of regulations and rules for procurement. Initial pilot projects may highlights barriers and constraints for applying ESCO business model in Iran. The pilot project may help identify issues to be modified (legally and procedurally) to accelerate the promotion of ESCO in Iran.
- ✓ The result of the model projects should be included in database to be used for the basis of national base for analyzing EE&C potential by type of buildings.
- ✓ Dissemination of information, publication of periodicals, award for EE&C, etc are important activities for promoting ESCO business.
- ✓ Regular meeting of engineers and executives for exchange knowledge and experiences. Organizing seminars and study meeting, etc to improve quality of services
- ✓

2-5 Strengthening of awareness for the needs of the building sector (Priority Program # 5 and 6)

- ✓ As for new buildings, training for owners, etc, a variety of educational program is carried out. One day-long free audit funded by the government is effective approach for the building owners to know the importance of EE&C as well as its EE&C potentials.
- ✓ Recommending EE&C renovation by audit program will lead to prospective customer of the market.
- ✓ Further provision of precise audit to identify approaches for improvement of EE&C. Improvement of operation and maintenance, minor renovation, etc may led to larger investment for EE&C in the long term.

Phase 2 (2014 to 2016)

- ✓ Continuation of the Activities in the Phase 1
- ✓ Project formulation through extended energy audit and pilot projects
- ✓ Completion of the Training Center. Extension of training program using the training center.
- ✓ Award to successful ESCO businesses and ESCO projects
- ✓ Expansion of membership of ESCO Association. Monitoring of ESCO business activities.

9. Issues to be considered, risk analysis

(1) Organizational Arrangement (Clarifying the Role of MOE, collaboration with other ministries, especially old MOHUD)

- ✓ Jurisdiction of MOE is EE&C with a focus on electricity. MOE is responsible for coordinate with other ministries on different aspects. As discussed, the proposed training center consists of a variety of training subjects and contents; MOE's most important responsibility is coordination among different ministries. In particular, architecture and building is jurisdiction of old MOHUD. Heat with petroleum is that of Ministry of Petroleum (MOP). These ministries are responsible for research and development, as well as human resources development of the respective field. MOE takes overall responsibility of coordinating the establishment of the training center for EE&C of the building sector.

- ✓ There are many seasoned instructors in electric power sector in the existing training centers affiliated to MOE. They do not have adequate experience in teaching EE&C for the building sector. The training, therefore, should be developed by collaborating with old MOHUD, especially its provision of human resources and technical support is pre-condition of the establishment of the training center.

(2) The Role of the Experts in Architecture

- ✓ The technical cooperation for EE&C for the industrial sector carried out at Tabriz was a transfer of a training package developed by Sumitomo Metal Industries in Kashima, Japan. It was a localized training program for preparation of energy manger certification program. In the other hand, the proposed EE&C training program for the building sector needs a more diverse technical subjects. The technical contents include all aspects of planning to completion of building project as well as commissioning to operation and maintenance. The acquisition of such capacity is through experiential training method by utilizing newly developed training facility. The curriculum development must be undertaken when the description of training facility is completed mainly by the C/P who are knowledgeable to Iranian construction and EE&C market situation.
- ✓ The specific technical contents of the training program may include such subject as land selection, determining specifications of envelops, spatial design, HVAC system design, construction and installation, and inspection. The basic knowledge for EE&C shall be provided by experts, possibly dispatched from overseas in form of technical assistance. The knowledge should be localized by the counterparts to adopt Iranian environment and market situation. In addition technical adoption to meet with local regulations is necessary. Especially technical adoption such as interpretation of traditional passive design is integral part of the contents of the training. Therefore, the development of curriculum, textbook should be initiated by Iranian side.
- ✓

(3) Securing Counterpart Personnel

- ✓ As discussed above, MOE's mandate is policy formulation and its affiliated institutions such as IEHT and SABA are responsible for policy implementation, MOE itself has limitation in terms of number of employees knowledgeable for EE&C for the building sector. It also has constraints to secure adequate number of core trainers who can instruct and teach the most up to date subject in building EE&C. The question the Study Team would like to pause at the time of writing is whether or not MOE can provide sufficient number of able counterparts when the technical cooperation is started. The most part of the previous technical cooperation was a localized package of training transferred from Japan. When it was implemented, curriculum, textbook, handout and teaching methodology had references. Therefore the localization process was completed in relatively short period of time. The proposed training program employs experiential learning approach to teach all process of planning, construction, completion inspection, and commissioning.

(4) Development of Textbook and Manuals

- ✓ Technical cooperation to be carried out in each sub-component requires development of

textbooks, manuals, guidelines, etc in a systematic manner. This should initiated by C/P because of above reasons.

Subcomponents	Teaching Materials	Contents/Target	By Whom	Remarks
1-1 Practical training for enhancing EE&C technology for the building sector	Guidelines	Engineers and Architects (Plan, design, supervise, construct, operation and maintenance, inspection, etc.)	Old MOHUD （MOE）	Requirements rather than specifications of technologies (to avoid outdated)
1-2 Establishment of Clearinghouse for publishing information on EE&C technologies	Brochures, catalogs, pamphlet, etc	Catalog and brochures for EE&C equipment, etc. infor ation for energy efficient building, etc.	New technology= BHRC Brochures= MOE	Catalogs and brochures has inherited risks of outdate. To avoid such risks, manufacturer may post and publish through clearinghouse.
1-3 Strengthening of awareness for the needs of the building sector targeting to the owners of the building and developers	Textbooks	EE&C education (return on investment, new technology, etc.), good practice	MOE	Target may have non technical background
2-1 Training to Enhance of technical capacity for EE&C for the building sector enabling to provide energy audit and analysis	Textbooks, guidelines, standardized forms	Planning of audit, measuring, analysis, proposing renovation, F/S, etc.	MOE	
2-2 Development of financial frameworks for supporting EE&C	Procedures textbook	Linkage to commercial banks, F/S, credit analysis	MOE, MOF, Bank Association	Loan agreement should be commercial base.
2-3 Establishment of the procedures for ESCO business schematics	Standard agreement, guidelines, etc.	Procedures for performance based agreement, etc.	MOE	Introduction of good practice overseas
2-4 Establishment of ESCO Business Association	Bylaws	Incorporation of the association	MOE 、 SABA(?)	Introduction of good practice overseas
2-5 Strengthening of aware ess for the needs of the building sector	Textbooks	EE&C education (return on investment, new technology, etc.), good practice	MOE	Target may have non technical background (same as 1-3)

(5) Membership of Proposed ESCO Businesses Association

- ✓ SABA currently registers all kind of energy service providers as ESCO business without specific criteria. It is different from the type of the proposed ESCO Business. Action Plan aims at establishes ESCO Business entities which guarantee certain level of reduction of energy (i. e. performance guarantee contracts) with specific guidelines for business. The current registration schematics lack clarity in service level they provide. The technical level, particularly of energy audit capacity for ESCO business of the companies registered may vary company to another. In addition, SABA's overall capacity of providing ESCO related services is not fully measured because SABA does not perform energy audit itself. The effectiveness of ESCO Business Association depends on what type of membership it would. Accountability for the criteria is especially important when the associations are established.

(6) Initial Training Site During the Construction of the Training Center

- ✓ It is projected that the construction of the proposed training center takes approximately three years to complete. The technology transfer on EE&C for new building will be carried out during the construction of the training center as OJT. In the other hand, the training for ESCO Business and engineers to enhance energy audit shall need training sites of own until the construction completes. One possible alternative is that use of existing buildings for OJT on energy audit. Based on JICA's past experiences elsewhere, ensuring existing building for OJT site is not easy task, because it is difficult to make owners and tenants collaborate with the counterpart. It is very hard for existing buildings to provide training opportunity because of its relationship to tenants. The Study Team has similar experiences during the study to secure number and variety of audit sites. In the course of the proposed OJT for ESCO businesses as well as EE&C engineers, a commitment by Iranian side to secure adequate training sites needs to be reconfirmed.

10. Justification for Technical Cooperation

- ✓ This is technical cooperation aiming at establishment of unprecedented EE&C training center for the building sector. (There was a technical cooperation on EE&C for building design between Japan and China in the past. It was a research and development project between two national technical laboratories on heat insulation and conductivity. The latter is aims at research and development while the former aims at human resources development.)
- ✓ In the Phase 1, ESCO experts from overseas are necessary because no resources with expertise from planning, implementation and financing are available.
- ✓ Support to establishment of ESCO Business Association and dispatch of ESCO experts is justifiable because such experts can be recruited from the countries that has experiences and the market in ESCO businesses.

Implementation Schedule

Activities	2012	2013	2014	2015	2016	Remarks
1. New Building						
1-1 Practical training for enhancing EE&C technology for the building sector						Use of the facility is after 2015
1-2 Establishment of Clearinghouse for publishing information on EE&C technologies						
1-3 Strengthening of awareness for the needs of the building sector targeting to the owners of the building and developers						
2.既存建築物対象						
2-1 Training to Enhance of technical capacity for EE&C for the building sector enabling to provide energy audit and analysis						
2-2 Development of financial frameworks for supporting EE&C						
2-3 Establishment of the procedures for ESCO business schematics						
2-4 Establishment of ESCO Business Association						
2-5 Strengthening of awareness for the needs of the building sector						
(Note) Construction Schedule of the New Training Center						
Planning (Spec. and requirements defined)						
Design						
Negotiation for Building Permit						
Procurement						
Construction						
Inspection						
Commissioning						

Annex 10 Competency Map

Table A10-1 Competency Map (ESCO Engineers)

Job	Competency-1	Competency-2	Competency-3	Competency-4
1	1-1 A	1-2 B	1-3 B	
Propose	Able to propose proper technologies to the building owners based on the facts and data	Know the policies and regulations as to saving energy	Able to select the most appropriate facilities/equipments	
2	2-1 A	2-2 A	2-4 A	
Execute	Able to procure investment funds for saving energy	Able to procure equipment and facilities with low prices	Able to manage the project integrating makers and contractors	
3	3-1 A	3-2 A	3-3 A	3-4 A
Audit and analyze energy saving	Able to forecast and guarantee the potential of energy saving	Know a number of energy saving measures	Able to calculate energy saving effects (energy reduction ratio, energy cost ratio)	Able to analyze cost-benefit regarding energy saving measures
4	4-1 A	4-2 B	4-3 C	
Evaluate operation and maintenance	Able to evaluate and guarantee energy saving effect	Know operation and maintenance methods after handing over	Has software to calculate energy saving performance such as unit cost and PAL	
5	5-1 A			
Conduct sales activities	Know many users (clients)			
6	6-1 B			
Develop the enterprises capacity	Have training schemes to improve the in-house engineers' skills			
7	7-1 B			

Improve the market conditions	Able to propose energy saving measures to the government			

Table A10-2 Competency Map (Energy Users)

Job	Competency-1	Competency-2	Competency-3	Competency-4	Competency-5	Competency-6	Competency-7
1	1-1A	1-2 A					
Record the quantity of energy usage	Able to collect and file the energy data (building owners, tenant association, servicemen)	Know prices and quantities of electricity, gas and water usages					
2	2-1 A	2-2 A	2-3 A				
Report the quantity of energy	Able to report the energy usage quantity to the administration (Building owners)	Able to show energy data available from the building owners to tenants	Able to share energy data among stakeholders				
3	3-1 A	3-2 A	3-3 A	3-4 A			
Set goals for energy saving	Know the problems of energy usage at one's own building (or household)	Have an attitude to make active efforts for energy saving	Able to make goals for en energy saving	Know that energy saving serves for national security			
4	4-1 A	4-2 A	4-3 B	4-4 B	4-4 B		
Gather and disseminate information	Know effectiveness and/or methods of energy saving technologies	Know methods and costs of energy saving	Know companies and friends who supply energy saving information	Able to disseminate information on energy saving by word of mouth	Able to take advices from consultants (advisor)		
5	5-1 A	5-2 A	5-3 A	5-4 A	5-5 B	5-6 C	
Conduct energy saving activities (operation)	Able to pay for energy saving efforts and suggestions by the maintenance company (Building	Maintenance companies have an attitude to treat favorably operators/servicemen who can save	Able to make recommendations to the owners about energy saving (maintenance company)	Operators/servicemen know the importance of energy saving	Operators/servicemen can operate and maintain the machineries efficiently	Able to make daily energy saving efforts (switch off, open windows etc.)	

Job	Competency-1	Competency-2	Competency-3	Competency-4	Competency-5	Competency-6	Competency-7
	owner)	energy					

6	6-1 A	6-2 A	6-3 A	6-4 A	6-5 A	6-6 A	6-7 A
Invest in energy saving	Able to comprehend and value the recommendations from ESCO	Able to make energy saving investment decisions	Know to recover the costs of energy saving investment by saving energy (reduce costs by using less energy)	Maintenance company can recommend energy saving methods to owners	Able to prepare investment funds for energy saving (if investment is necessary)	Able to calcurate return on investment and purchase saving machineries/devices	Able to invest in operators/servicemen training
7	7-1 A	7-2 A	7-3 A	7-4 C			
Adjust interests among various parties	Able to build cooperative relationship between owners and tenants	Able to adjust multi-party interests within a building and an apartment (owners, tenant associations)	Able to construct a system that each household pays for gas and water, such system as for electricity	Able to persuade family members for energy saving (each household)			

Table A10-3 Competency Map (Architects and Engineers of Construction Company)

Job	Competency-1	Competency-2	Competency-3	Competency-4	Competency-5	Competency-6
1	1-1 A	1-2 A	1-3 A	1-4 A	1-5 B	1-6 B
Enhance work related knowledge	Know the necessity of energy saving (architects/mechanics)	Know energy saving technologies (equipment)	Know the examples of energy saving technologies (construction)	Able to design in accordance with the Building Code Article 19th	Know know-how to save energy without additional costs	Know the application procedures and framework of governments' subsidies for energy saving
2	2-1 A	2-2 A	2-3 A	2-4 B	2-5 B	
Develop, market, and install energy saving products	Know quality control methods	Able to control and secure quality in accordance with the specifications and plans	Keep compliance and abide by laws and regulations	Able to inform and market materials in specifications	Keep obsolete products as stocks for a certain period	
3	3-1 A	3-2 B	3-3 B	3-4 B	3-5 B	3-6 B
Share knowledge and experience of energy saving designs	Know the size and details of the heating system of the building	Know how to calculate thermal conduction	Know methods to increase heat isolation efficiency	Know the methods to enhance air tightness	Know ventialtion methods with less energy loss	Know efficient lightening methods
4	4-1 A	4-2 A	4-3 B	4-4 B		
Propose technical recommendations	Able to make the client to understand the importance of every saving	Able to design a building that controls wind and sunshine by curtains and other devices	Able to recommend appropriate design and systems which accord the needs and environments of the areas	Know how to live to save energy （e.g. know how to efficiently open and close windows）		
5	5-1 A	5-2 A	5-3 A	5-4 B	5-5 B	5-6 B
Develop new technologies	Able to develop energy saving technologies	Has knowledge on materials and construction methods in and out the country	Able to design and control passive solar for the environment (able to control the environment without machineries)	Know the characteristics of energy saving materials	Able to offer materials easy to use	Able to estimate the effectiveness and lifetime of the existing equipment and machineries

6	6-1 A	6-2 B	6-3 B	6-4 B		
Manage setting up and construction	Able to manage construction works (supervise construction companies, workers)	Has capacity to negotiate with partner companies and contractors	Know good construction contractors	Able to lay bricks without void		
7	7-1 A	7-2 A				
Work and collaborate with architects and equipment designers	Able to recommend flexible systems in accordance with the clients in relation to energy saving design	Able to exchange opinions and jointly design a building for energy saving				

Table A10-4 Competency Map (Government Officials)

Job	Competency-1	Competency-2	Competency-3	Competency-4	Competency-5	Competency-6	Competency-7	Competency-8	Competency-9	Competency-10
1	1-1 A	1-2 A	1-3 B							
Understanding current situation	Know EE&C related laws and regulations	Know situations and awareness of EE&C enterprises	Know global trends and international environmental funding sources							
2	2-1 A	2-2 A	2-3 A	2-4 A	2-4 B					
Analyze and plan	Know effective policies for EE&C and conditions for implementation	Understand the structure of EE&C legal institutions and utilize them	Know the latest EE&C technology and assess its applicability to home country	Have building data (floor size, amount of energy usage, capacity, time for use) for EE&C	Make policies to promote economic development with EE&C in building sector					
3	3-1 A	3-2 A	3-3 A	3-4 A	3-5 A	3-6 A	3-7 B	3-8 B	3-9 B	3-10 B
Implement	Allocate budget for EE&C promotion	Understand economic impact of energy prices and set proper subsidies	Establish credit scheme for EE&C investment	Liaise and coordinate with other ministries/organizations	Have an attitude of promotion of building EE&C as the state policy	Local government: disapprove construction application that does not fit building code	Identify and control the stakeholders for EE&C promotion	Understand and establish EE&C investment and return scheme and persuade the stakeholders.	Establish research organizations for EE&C promotion	Make guidelines for producers to integrate EE&C design
4	4-1 B									
Improve market conditions	Able to propose EE&C countermeasures to									

Job	Competency-1	Competency-2	Competency-3	Competency-4	Competency-5	Competency-6	Competency-7	Competency-8	Competency-9	Competency-10
	government									
5	5-1 A	5-2 A	5-3 A	5-4 B	5-5 B					
Awareness raising	Publicize importance of EE&C and environmental issues and raise awareness among public	SABA,IFCO,BHRC: Diffuse and raise awareness on Energy Law, Building Codes, subsidy cut, etc.	Local governments : user-friendly extension for operation of laws/regulations	Professional organizations/ Consultants: diffuse building EE&C in its own fields	Min. of Education: raise awareness on EE&C through school education					
6	6-1 A	6-2 A	6-3 A	6-4 B						
Human resource development	Identify and develop human resources for EE&C promotion	Min. of Education, Min. of Labor & Social Affairs: Analyze knowledge/ability for promotion of building EE&C	Develop enterprises of EE&C planning, implementation, assessment (e.g. ESCOs)	Min. of Education: Know EE&C education in other countries						
7	7-1 A	7-2 A								
Evaluate	Make policies for EE&C promotion and evaluate the results	Evaluate responses for various EE&C promotion methodology (e.g. raising								

Job	Competency-1	Competency-2	Competency-3	Competency-4	Competency-5	Competency-6	Competency-7	Competency-8	Competency-9	Competency-10
		prices, emission control, commendation)								

Table A10-5 Competency Map (Financial Institutions)

Job	Competency-1	Competency-2	Competency-3	Competency-4	Competency-5
1 Assessing the feasibility of the project	1-1 A Can evaluate and analyze the risks associated with the project	1-2 A Can analyze payback period of investing to EE&C equipments			
2 Managing credit of borrowers	2-1 A Can set conditions (e. g. interest rate, etc) appropriate for the risks	2-2 A Can assess credit rating of borrowers	2-3 A Can collect credit by necessary means when the loan payment is regularly made	2-4 A Can prepare contractual agreement for EE&C project	
3 Proposing EE&C projects	3-1 A Can explain merits of installing EE&C equipments (leasing)	3-2 B Know importance of promoting EE&C and prosperity is EE&C as a business	3-3 B Can market EE&C related loan to prospective customers (e. g. owners and investors of building)	3-4 C Can use channels of proposing low-cost EE&C measures such as system optimizations, etc.	
4 Formulating CDM projects	4-1 A Know the framework of CDM project	4-2 A Can analyze cost and benefit of CDM project	4-3 B Can prepare PIN and PDD for CDM project	4-4 C Can carry out CDM project by bundling multiple EE&C projects	4-4 C Know prospects of CDM projects and its market
5	5-1 A	5-2 A	5-3 C	5-4 C	

Job	Competency-1	Competency-2	Competency-3	Competency-4	Competency-5
Analyzing EE&C market and its environment	Know measures and support for ESCO provided by the government	Know the framework of ESCO projects	Know prospective market of ESCO business	Know mid to long term trend of energy price (e. g. petro, gas, etc.)	
6	6-1 A	6-2 C			
Furnishing supporting measures for EE&C	Can dialogue with the government for establishing subsidies and provision of low interest loans, etc.	Can provide credit to EE&C related R&D projects carried out by the private sector			
7	7-1 C	7-2 C	7-3 C		
Securing Financial Resources	Can ensure low interest money from overseas	Can form joint venture to minimize credit risks	Can hedge risks by bundling various EE&C related loans		
8	8-1 A	8-2 B	8-3 C		
Networking	Can establish and maintain network of ESCO business, manufacturers, etc.	Can form business forum to share industry-specific information, etc.	Can refer other business when necessary.		

Annex11- Comparison of Inst. Of Higher Education and Research Complex

Comparison of Inst. Of Higher Education and Research Complex

Items	Evaluation Criteria	Isfahan	Mashhad	Tabriz
Purpose		Education and training for MOE staff engineers		
Activities		- The Institute takes action to meet water and power industries educational and research needs within the framework and the regulations of the Ministry of Energy and the Ministry of Science, Research and Technology - Provision of education and training for MOE staff. Undergraduate education in applied science. Applied research, technical services and consulting for the related industries. - Each center is established as one of six (6) regional HERCs (Higher Education and Research Complex) under IEHT (Institute of Energy and Hydro Technology). Locations include: Azerbaijan, Isfahan, Khorassan, Qarb, Fars and Khozestan) - There are eight other training units in Mazanderan, Tehran, Guilan, Zahedan, Qanat, Qeshm, Bonab and NTCEM in Tabriz. - AHRC(Azerbaijan Higher Education and Research Complex) provides a training program specialized in industrial EE&C. Currently, it is the only institution in Iran to carry out in-service training program on EE&C.		
Year Established			1980	
Provinces covered.		Central Region	7 province in the northeastern Iran (covers a half of total national land area)	The northwestern Iran (including eastern Azerbaijan, etc.)
Area	Availability of the space (land or building) for prospective training center on EE&C for building and housing	Total Land Area: 40,000 sqm Lodging facility hosting 400 persons (8,000 sqm) There are some spaces for the prospective TC in the premise. The largest research institute among six research complex under MOE.	Total Land Area: 100,000 sqm Lodging facility with 270 persons capacity There are four educational complexes in total of 10ha land area. Un-used space, originally planned for new dormitory may be converted to the prospective TC.	Total Land Area: N/A sqm Lodging facility available A small annex space (applox. 100 sqm) is available in the premise of the existing NTCEM (National Training Center for Energy Management) Other spaces available were not explained.
Building and Facility	Availability of existing facilities in the complex	Total Floor Area of building and facilities: 40,000sqm Existing facilities (some lab and library, etc.) may be available.	Total Floor Area of building and facilities: 30,000sqm There are four buildings, 40 lab, 14 workshops, and cyber center (computer center?) available. A	Total Floor Area of building and facilities: N/A sqm There are many building, etc. in the premises.

			library with reading room available.	
Staff member	Availability of (administrative) staff & management for TC.	There is significant experience in managing education and research institution. The capacity to carry out education and training for architecture and the related disciplines is unknown.		The know-how for running TC on EE&C acquired through the previous TC w/ JICA (2002～5 years).
Faculty and teaching staff	Specialty, numbers, etc.	Total number of staff member: 72 Management: 8 Administration: 14 Academic: 20 None of above: 30	Total number of staff member: 102 Management: 11 Administration: 36 Academic: 20 None of above: 40	Total number of staff member: 85 Management: 10 Administration: 15 Academic: 30 None of above: 30
Academic departments and programs	Availability of EE&C related department and programs	Departments: Energy, Computer and Control, Management, Water-Waste water & Environmental Engineering (civil engineering, hydraulic structures, ground water eng. Contract management), Electric, Energy& Power Plant Engineering (energy saving in buildings: technician, electrical mechanical design in buildings (technician) There is civil engineering department along with electric and mechanical engineering. Programs related to building design is one of strongest points of Isfahan.（Structure, Geo-Technique, Environment, Energy） Some faculty members in electric and mechanical engineering specialized on building and	Record of all subjects covered in 2009: 243 (Number of EE&C related subjects taught: unknown)	TC provides training for energy mangers w/ focus on industry in heat and electricity areas. Other subjects include: 1. Civil and Environment and Water 2. Electric Power and Distribution 3. Electric Power Generation 4. Computer 5. General Science? 6. Energy Conservation Facility and the training program was designed based on Japanese EE&C training on heat and electricity (Sumitomo Metal Industry in Kashima, Japan)

		construction.		
Number of students		Total enrollment in 2009 was 16,000 (Male 12,800, Female 3,200) 30 participants / course. 30 class hour/week. 250participants /month Maximum capacity for training is 1000 participants. Short-term trainees maximum of 12,000/ year	Total enrolment for EE&C related subjects, 40 (from central and local governments) and 80 (from the private sectors)	The total enrollment was not disclosed in the survey. Approx 3,000 completed the EE&C training at the TC Majority of participants are from factories nearby. They take the course with recommendation from the managers of the factories.
Short-term courses	Availability of short term training courses	- Water and waste water eng. - Energy Management - Power plant eng. -Electrical eng. -Management -Control system& computer science	- Short-term training course for MOE. Training course for MOE specialists such as engineers in electric power plants, etc. - Tailored training programs for industry: (i.e.) Nyshabour steel complex, national company of gas transmission, Hasheminejad refinery, telecommunication engineer - International training program provided to such counties as Tajikistan on dam, hydro-generation, Afghanistan on electric power, gus turbine power generation and distribution, Turkmenistan on water treatment,	Training program on building MOE 向 available. TC provide technical consulting services to local industries (SABA has a record of the services.)
Evaluation of training	Methodology of Quality assurance for training and development	Questionnaire survey (peer evaluation, etc.) is generally used for evaluation. The evaluation results will be reflected to the instructor's contract, etc. (which is very common practice in Iran.) Evaluation of achievement of participant is mostly conducted by paper-based examination.		Internal energy audit shall be practices when the participants are completing the training program. He/she shall submit an audit report of to his/her factory to the center.

				The report is to be further evaluated and if it is acceptable, certificate of completion is granted. Assessment for granting certificates is carried out by Mr. Zarbakhsh, Manager of Training office, SABA.
Geological features and characteristics	Accessibility, availability of accommodation, weather, etc.	Located in the center of of Iran. Only 400kmfrom Tehran. Air and land transportation is fully available. Known for its old heritage. Diverse climate with cold and mountainous イ in the west of the city. Temperature difference up to 30◦c in eastern and western side of the city. Diverse architectural style in the city.	- The second largest city in Iran following Tehran. - Good access to airport. Close proximate to central highway. - Many cultural and religious heritages including the famous holly shrine. Attracts many tourist and travelers. - Approximate the half the hotel is located in Mashhad. - Gateway to central Asia, other Middle East countries. (Share cultural heritage because of historical background of Japan)	Tabriz is the fourth largest city and is one of major industrial center in eastern cities. The city is located to the border of Turky and Armenia and is a gateway to EU and central Asia through Azerbaijan (speaks Turkish language) .
Local resources available	Any education and training resources that may be available for TC.	May be able to collaborate with (national and private) universities and colleges. Extensive concentration of science and technology in the city. Isfahan is known for home of Architecture and building engineering.	Mashhad （Ferdosi）University is National Univ. And Azar University (Private). Faculty member can teach each university.	
	Support from industries, etc. Support from construction industry and other building-related	Major construction material supplier (of cement, bricks, steel beams, pre-cast concrete, etc) has supported to the complex. During the sabbatical break, faculty	Training for power station is carried out here. Specifically tailored training for the power industry available.	NTCEM collaborates with local industry for supporting and promoting EE&C. SABA works with the institution as an external evaluators.

	industries, etc.	members may contact with the companies to acquire the up-to-date technology, etc. Meeting among departments to revise and develop curriculum. The revision may be based on the needs of industry reflected.		
	Support from local government.		The mayor is a civil engineer, and the speaker of the local assembly is a professor of the institute. Local government and industry is supportive to the establishment of the TC.	
Positive Elements		Short-term training on electricity for building has been carried out since 1995. A EE&C training program tailored for Mobarak Steel Co. implemented. There are professor specialized in mechanical engineering. Long-term training (=undergraduate course) will establish a (2 year-long) diploma course from Feb 2011. Energy audit project aiming at industry carried out.	-]Educational linkage with industry to be strengthened. - Ground work for establish as an educational center for EE&C for building in progress. - In search of a new energy management site - New TC shall be established at both Isfahan and Mashhad. 12,000 engineers are considered the target of the training.	The center is EE&C center for industry. The center provides lecture on industrial benchmarking on energy consumption and other related subjects.