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ANALYZING DURABILITY PROPERTIES OF INSULATED CONCRETE IN ENERGY REDUCTION FOR RESIDENTIAL BUILDINGS

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ABSTRACT

The investigation and analysis of the Insulated Concrete Form (ICF) indices for the residential buildings cause the emergence of energy-related values in such a highly valuable industry. Permanent molds, made of polystyrene, are the most important components used in the reinforced concrete structure system with ICF that are used in the concreting and reinforced concrete wall construction stages and are regarded as part of the wall upon the termination of the foresaid stages. In such systems, the walls are concreted inside a polystyrene mold. The roofs are made using reinforced polystyrene molds in a voided form and the entire parts are made in a factory and assembled on site. The enjoyment of the latest ICF knowledge and technique and active and creative confrontation with such a process and analysis of the characteristics of such an industry and extraction of such an industry's implicit results to make a better use of the technology for reaching construction and architectural methods along with the preservation of the main themes are the solutions suggested for the future architecture in the current research paper. The present article tries introducing the use of ICF technology as a sort of construction method using masonry compliant with the living environment in line with energy consumption reduction through recognizing the various characteristics of ICF in residential buildings and the successful examples made based thereon.

Keywords: *Residential Buildings, Precast Concrete, Insulated Concrete Form (ICF), Durability, Energy Consumption Reduction.*

INTRODUCTION

The building design is the first line of defense against climatic factors exerted on the building from outside. For a full-scale reduction of energy costs in a building for all of the climatic regions, the buildings that are constructed corresponding to the climatic design principles minimize the mechanical heating and cooling necessities and make use of the natural energy existent in the periphery of the buildings instead (Watson and Liz, 1937: 4). Precast parts are amongst the factors contributing to the cost reductions. Precast part construction, as an industrialized method of building construction, meets the novel engineering requirements in the smallest time period (RWM, 2003: 12-45).

Considering the immethodical use of energies and the wastage of them inside the buildings, the UN assembly has predicted a temperature increase ranging between 1.4°C and 5.8°C during the upcoming hundred years (Antony F., 2007, 44).

Insulated concrete forms (ICFs) are seen as a gigantic progress in the construction industry in terms of wall insulation against humidity and heat as well as in regard of lightening the structures, speeding the construction and installation processes and an array of the other cases. In Iran, the ICF technology has become popular as ANISTA and it is made in such a way that two

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polystyrene layers are connected to one another and filled with concrete in the hollow space between them and it does not need any specialized workforce. These forms are deployed in various shapes and places, including an anchor retaining wall and roof molds and they can be joined to the other building systems and components (Jamasbi, 2011). The system was first invented during the 1950s to 1960s in Germany from where it was rapidly dispersed into Europe and the entire world. Now, more than 8% of the low- and medium-height buildings are built using such a system in the US and Canada (Golabchi and Mazaheriyan, 2012: 120).

The molds of the system are pre-casted incorporating two foam plates connected by means of a series of holders; they are also made in the form of isolated plates that are connected on construction site using special holders. They are most widely applied in building construction (Khorrami, 2008: 6).

Nowadays, over 8% of the low- and medium-height buildings in the US and Canada are constructed using ICF that has brought about a revolution in the progress of the global construction industry for residential, business and administrative buildings. It is used in a daily increasing manner for such reasons as its unprecedented ease of installation, energy productivity and cost reduction in contrast to the other methods (Nikravan, 2000: 73-83).

The necessity for making use of building systems and new construction materials parallel to the enhancement of the construction quality and increase of the construction speed and elevation of the strength against accidents and prolongation of the buildings' useful life is currently posited in a highly accentuated manner and considerations like prevention of energy wastage and energy saving in respect to the fossil fuels and the extravagant costs of construction projects necessitate offering of solutions in line with the practical use of novel systems and new masonry; in the meantime, there is a need for taking essential steps in the scientific and specialized communities concerning the revision of the modern methods of building construction processes as a subsequence to which these methods could be rendered conformant to Iran's architecture and adjusted to the culture of this territory.

These methods will cause in the long run the creation of optimum conditions in the residential building industry. Thus, the current research paper attempts to evaluate and analyze the attributes of ICFs in terms of their climatic functions and energy consumption with respect to the type and performance of masonry as well as the type of molding and implementation so that the important energy reduction indicators can be determined and extracted.

The History of Concrete System Reinforced with Insulated Concrete Form (ICF):

Concrete system reinforced with ICF is a filler wall whose molds are permanent and are considered as part of the wall after concreting. These infilled walls act as thermal insulators. The system was first invented in Germany during 1950s to 1960s and it was quickly propagated to Europe thence to the entire world. More than 8% of the low to medium height buildings in the US and Canada are constructed using such a system.

ICF is a revolution in the global construction industry and it can be implemented in all residential, business and administrative buildings. It enjoys a daily increasing use for its easy installation, energy productivity and cost reduction in contrast to the other methods.

Study Theoretical Background:

Fatemeh Bahraminejad Maghou'eiyeh and Muhammad Reza Rafe'ei (2011) state in a study under the title of "comparing ICF and TCF" that the reinforced concrete works are being carried out recently using polystyrene insulated concrete forms in which case there is no need for

making use of ancillary molds while metal or wooden molds are required in TCF that are removed after concreting and concrete setting operations (Bahraminejad Maghou'eiyeh, 2011). In another study titled "introducing the ICF", Samira Zia'a Al-Din and Atefeh Shamsa'ei in 2011 dealt with the idea that ICF offers a special type of formwork wherein the light molds are installed permanently and filled with fluent concrete. The yield of the study was the construction of structural components including walls that were completely integrated and acted as an appropriate insulation against heat, cold and sound. The study dealt with the technical properties of the used masonry and the implementation methods.

In another study called "the insulated concrete form system", Doctor Behrouz Muhammad Kary and Engineer Kian Khalili Jahromi (2008) the various types of facades and outward faces of the buildings can be installed stated that in this system. To do so, the required metal segments are connected using bolts or rebar to the concrete that is poured in the space between two insulated layers. Also, in another study about using ICF in construction industrialization, Hussein Jamasbi et al (2011) expressed that ICF is a gigantic progress in building industry in terms of wall insulation against heat, lightening of the structures in a faster pace of installation and a great many of the other cases. The technology is known as ANISTA in Iran and it is built in such a way that two polystyrene layers are joined using certain connectors and infilled with concrete and such a work is needless of the specialized workforce. The forms or molds can be installed in various forms and on different parts including the anchor retaining walls and roof panels and it is possible to employ them concomitantly with the other parts of the building. The study also evaluated the performance of ICF.

Table 1: investigating and summing the various research on ICF (source: the author, 2016)

Theories on ICF and TCF		
Fatemeh Bahraminejad Maghou'eiyeh and Muhammad Reza Rafe'ei, 2011	Comparing ICF and TCF	In ICF system, the reinforced concrete work implementation is carried out using polystyrene insulated concrete forms so there is no need for using ancillary molds; whereas, metal or wooden molds are utilized in TCF systems and they will be removed after the concreting and setting operations.
Samira Zia'a Al-Din and Atefeh Shamsa'ei, 2011	An introduction to ICF	The product of the work was the construction of structural components including walls which were completely integrated and acted as good insulation against heat, cold and sound. The study dealt with the technical properties of the masonry used and the implementation methods.
Behrouz Muhammad Kary and engineer Kian Khalili Jahromi, 2008	ICF systems	The system incorporates molds made of light and refractory Styrofoam and it is an appropriate insulation against heat, cold and sound and provides energy saving at least up to 75%. The other parts and appendants of the building, including the doors, windows, electrical systems and so on, are easily installable on the prefabricated molds. The easy and fast construction of the workshop without requiring any special heavy machinery and even by the assistance of semi-skillful workers are amongst the other merits of such a type of building system
Hussein Jamasbi et al	ICF in building industrialization	ICF is considered as a big advancement in the construction industry in terms of the wall insulation against humidity and heat and provides for the lightening of the building and fast installation and a great many of the other cases. The technology is known as ANISTA in Iran and it is built in such

		a way that two polystyrene layers are joined using connectors and infilled with concrete. The work does not need any specialized workforce. The forms or molds are deployed in various shapes on different parts of the building, including an anchor retaining wall and roof panels and it is possible to use them in combination with the other systems and building components. The article evaluates and investigates the performance of ICF.

MATERIALS AND METHODS:

The present study tries dealing with the investigation of the structure and use of ICF as a technological advancement in the today's architecture based on the extant resources and documents so that the contemporary architecture value could be made more clarified to the extent possible. In line with this, the current research paper takes advantage of a descriptive-analytical method using library research and the existing documents and evidence.

The Importance and Necessity of Research:

Part of the today's architectural needs is related to the discussions on novel techniques and there would come about destruction and annihilation of nature if appropriate solutions could not be devised and this is the duty of the architects and construction industry. So, the architects are obliged to resort to new designing methods and proper solutions so that such adverse effects could be decreased. Thus, the present study is seeking to classify the ICF groups so that the current research paper could be rendered more academic and scientific and, in doing so, uses can be pointed out for the ICF as a valuable solution in the today's realm of the architecture. There is paid a greater deal of attention recently to prefabricated construction materials in Iran and the improvement and enhancement of such precast parts require a greater many of the research and studies (Downing, 2002: 283-290).

The lack of sufficient knowledge and awareness regarding the vernacular construction materials has made the people and the building-construction specialists willing to make use of the industrial masonry for which there is enough applied information. The necessity for elucidating the reasons behind the use of such types of masonry in the buildings parallel to boosting the economical productivity, on the one hand, and energy saving enhancement during the masonry production stages, on the other hand, lies in the construction of modern edifices as well as in the better preservation of such innovatively constructed buildings.

Study Theoretical Foundations:

Insulated Concrete Form (ICF):

Combining the reinforced concrete, as the retaining component, and the expanded polystyrene molds (EPS), as the thermal insulator and concrete form, is one of the newest construction systems that has been expanded recently and is recognized as the insulated concrete form (ICF). The system was invented in Europe during the 1950s to 1960s and it was employed as a suitable technology in the construction industry in a limited manner and it was swiftly welcomed in the world due to its numerous benefits in terms of both architecture and building. Reinforced polystyrene molds are the most important components of such a permanent mold system that are utilized in concreting and construction of reinforced concrete walls stages and are rendered integral parts of the wall upon the termination of the concreting operation. These insulated

concrete forms prevent energy wastage inside the complexes (building and housing research center, 2010: 4-50).

Figure 1: stages of constructing walls based on ICF method (source: mapsa.co.ir)

Construction Process:

The foundation in ICF system is laid based on strap footing or expanded footing design. Upon reaching the foundation level, the bedding has to be prepared and tuned with at least ten centimeters of C10 concrete (lean concrete). Then, the molds and steel reinforcements are placed and concreting begins (Ibid, 4-50). The dwelled reinforcements should be installed afterward. In order to provide for the correct placement and establishment of the compartments in the intended places, cold-rolled box-shaped profiles or wooden segments can be applied. The wooden parts are removed post-concreting but the steel profile remains underneath the thermal insulator layer (Nikravan, 2000: 73-83).

Figure 2: concrete molding

Classification of the Insulated Concrete Forms:

In research classifications, the cases that share the same applied and practical signs and principles are essentially put into the same group. Science ranking makes us aware of the idea

that how the science should be divided into separate divisions and how far or close are these divisions from one another. Moreover, the process and the quality of the mankind's knowledge progress can be discerned through scientific categorizations that can be used for proposing more appropriate methods of teaching science. By science ranking, the demonstration of the relations and the hierarchies are intended. Scientific grouping enables a genuine unity in the science (Fazelniya, 1977: 5).

The following classes can be pointed out in a categorization of ICF as mentioned in the research performed in this regard:

- ICF classification based on formwork and implementation orientations
- ICF classification in terms of masonry used
- ICF classification in terms of architectural constraints
- ICF classification in terms of performance, heat, cold and acoustic insulation considerations
- ICF classification in regard to the economical concerns

ICF System in Regard to Paneling and Implementation Orientations:

The ICF mold system is categorized into three sets, namely horizontal, vertical and diagonal, in terms of formwork:

1) **Horizontal System:**

The paneling is conducted horizontally in such a system. The system molds are blocks featuring indentations and protrusions enabling easy interlocking of the compartments. The blocks usually are built with dimensions near to 120cm×30cm. Juxtaposed one at the side of the other, these blocks make for a mold through which a concrete wall is installed. Such an ICF is also known as block system.

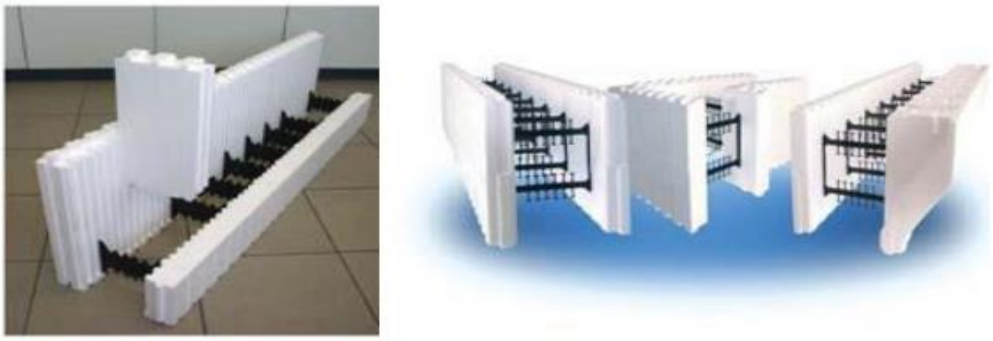

Figure 3: horizontal paneling system implementation

1.1. Block System:

The molds of this system enjoy smaller dimensions with respect to the other types and they are usually produced up to 120cm×30cm in dimensions and 5cm in thickness. These molds are made of smaller segments that are easily interlocked for their being furnished with indentations and protrusions. The rebar working is usually conducted onsite in the majority of the block mold systems.

1.2. Strap or Plate System:

These parts are built with 240cm×30cm dimensions and they look like the block molds in terms of the other characteristics.

2. Panel System:

The system is implemented using larger polystyrene plates. The plates are commonly fabricated using plates 120cm in width and the same height as the story's height. The rebar works are conducted in a unidirectional or bidirectional manner in some cases. The customization of the panels is also possible. In such a type of ICF, the transversal parts between the two panels are usually made of steel and perpendicularly welded to the main rebar works. Besides stabilizing the distance between the two walls, such an implementation method provides for the creation of the front face with the elongation of the walls towards the polystyrene parts using a plastic segment attachable to both the transversal backing part and the spot where these parts are connected using bolts.

2.1. Roof Panel:

These panels are produced 60cm in width and 16cm to 32cm in thickness with the requested length. There are two bent box-shaped (or Z-shaped) profiles beneath the panel featuring an appropriate resistance to the loads imposed when installing and erecting the system. In the meantime, the panel can be used as a support when performing fine working for mechanical hitching of any fine work system, including the interlocking of the gypsum-made panels or plasterboards. The lower edges of the cross-section are interlocked in the form of tongue and groove with the adjacent panels. And, sufficient space is provided in the upper section for the rebar work as commonly carried out in the rebar concrete support blocks. There is no need for joist for the implementation of the roof and the concreting of the roof and the rebar support blocks are done simultaneously that will finally lead to an increase in the speed and quality of the work. The supporting buttress can be spaced up to 2 meters when concreting. To perform traditional gypsum works, the fine works can be carried out using metal or plastic mesh and hitching the gypsum work to the roof.

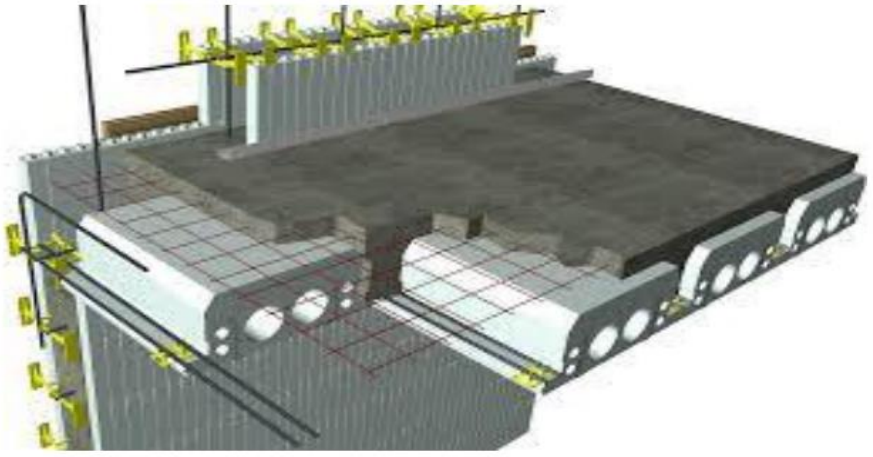

Figure 4: ICF used as roof panel (Source: www.quadlock.com)

2.1.1. Structure Implementation Stages:

To implement such a type of panel, firstly a strap footing is implemented considering the intended reinforcement bars required for connecting the ICF walls to the foundation. In order to slide the parts exactly into their

places, a hypothetical line is delineated on the reinforcement bars and the wooden or box-shaped parts, 5cm×10cm in dimensions, are connected thereto and the panels are installed in their places and backing parts are installed to support the panels following which concreting operation is performed.

3. Vertical System:

In this system, the molds are installed at the side of one another in the form of vertical films. The molds enjoy a larger size as compared to the horizontal system molds and the reinforcement is applied in the workstation as envisaged necessary. The following figure illustrates the constituting components of the system.

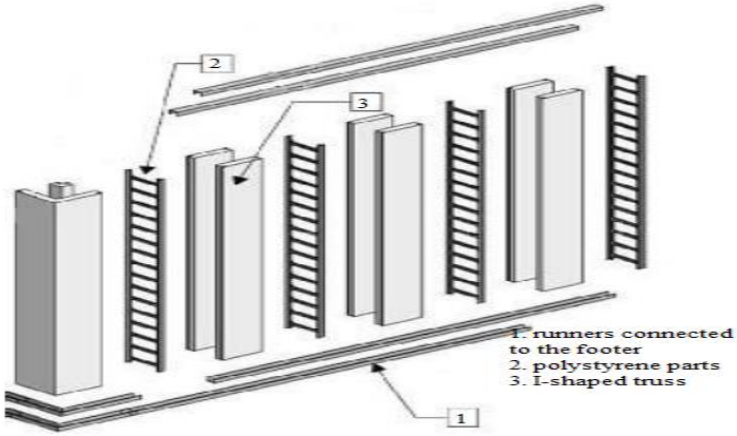

Figure 5: vertical system (source: Bahraminejad Maghou'eiyeh, 2011)

Nowadays, the vertical mold systems are more frequently utilized than the other formworks for their advantages that will be introduced further below. This method was selected as the best building technology by the housing modern technologies institute in the US in 2007.
The Advantages of the Vertical System in comparison to the other ICF systems:

- According to the size of the molds and the way they are placed, the implementation operation can be carried out more rapidly than the other two systems.
- The molds are standalone forms and it is readily possible to have access to the inside part of the mold for performing complementary works and/or for correcting the reinforcement and/or fixing and informing the reinforcement bars to one another while it is not at all possible in the other two systems. I-shaped molds and beams are carried to the workshop in separate and the transportation costs are a lot lower than the panel system.
- Also, according to the dimensions of the molds, they can be easily carried by a worker with no need for asking another person's assistance and/or crane (Bahraminejad Maghou'eiyeh, 2011).

Vertical System Implementation Method:

After the foundation was laid and the intended reinforcements were devised, galvanized boxed beams (runners) are installed in their place using a nail gun. The molds installation begins from

a corner of the building. After each mold was placed, an I-shaped truss is used so as to ease the installation of the other molds and the mold placement continues the same way for whole the building.

After the molds were placed in their positions, it is now time for reinforcement. Of course, it is worth mentioning that one attribute of the system is that the molds installation can be started at first from one side and the steel reinforcement work can be commenced from the side the mold installation is terminated.

Concreting is conducted after steel reinforcement of the molds using special machines. Of course, such machinery does not exist in the country unfortunately and ordinary cranes are applied instead.

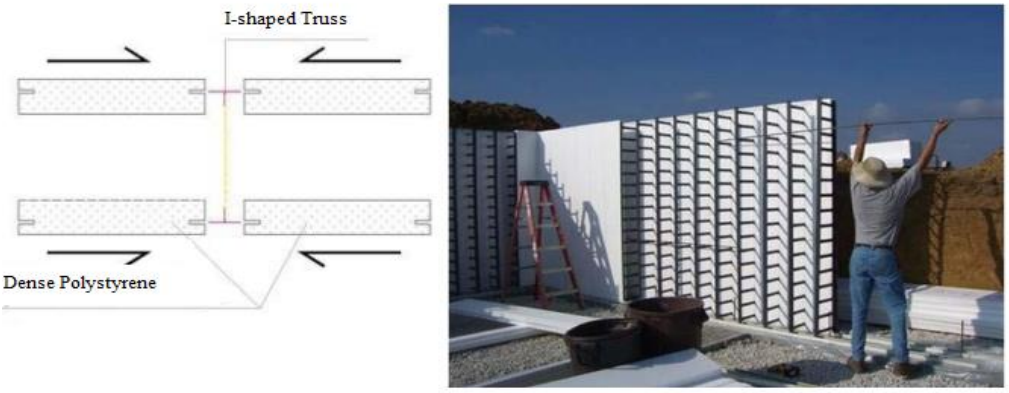

Figure 6: vertical system implementation method (Bahraminejad Maghou'eiyeh, 2011)

Masonry Used in ICF:

Investigation of the ICF in terms of Construction Materials:

The ICF technology makes use of molds permanently embracing the fresh concrete and they are left in work forever. Essentially, the advantage of the ICF lies in fighting the environmental conditions giving rise to the corrosion of the construction materials and protecting the concrete and/or its insulation properties.

Predominantly, the masonry constituents of the ICF are either of the following four: molds made of polyurethane, molded forms made of expanded polystyrene (EPS) and molded forms made of extruded polystyrene (XPS) and/or forms consisted of a combination of EPS and composite cement.

EPS are usually offered at the lowest prices and it provides for favorable insulation against air. XPS2 are more expensive in contrast to EPS and provide for a 25% higher insulation and resistance against water.

XPS and EPS are both made of similar plastic (polystyrene) materials but are manufacturing in different processes of composite molds and cement. EPS gives higher resistance due to having cement as one of its constituents and the EPS parts are usually in need of a greater deal of effort when cutting and shaping and they enjoy an insulation a little less than the other molds.

Next, the durability attributes of the masonry used in ICF are introduced and identified.

The Durability Attributes the Effective Coefficients of the Constructional Materials Used in ICF in regard to Energy Consumption Reduction:

1) **Expanded Polystyrene:**
   A substantial fraction of the ICF molds is made of expanded polystyrene that is rarely replaced by such composites as polystyrene-cement, foam-polyurethane and/or plastics. The pre-expanded polystyrene granules are usually cast into dies and shaped into integrated molds in a process under the influence of heat and humidity (water vapor under compression). The insulated part (expanded polystyrene) possesses a density between 24kg/m^3 to32 kg/m^3.
2) **Concrete:**
   The 28-day strength of the concrete in all of the technical certificates has been considered over 17 MPa and the gravel sizes used in the concrete have been recommended smaller than 19mm in the majority of the licenses. In a few numbers of the certificates, the gravel sizes have been made dependent on the wall thickness.
   The concrete fluency should be to the extent that it can readily take place inside the mold and minimum vibration could be required and, in the meanwhile, the concrete has to be dense and less porous. To do so, the concrete slump ranging between 100mm to 152mm has been prescribed.
3) **The Connectors:**
   The connectors used for connecting the side polystyrene layers are mostly polymeric. In the majority of the cases, high-density propylene is used to make these parts. Impact-resistant polystyrene can also serve this same objective. It has been observed also that some systems have employed steel connectors featuring galvanized coatings.

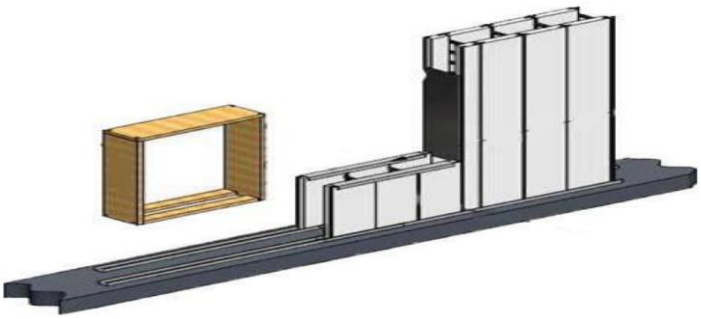

Figure 7: the method of installing the windows and openers in the system (source: Bahraminejad Maghou'eiyeh)

4) **Rebar**:
   The rebar used in this system are the same corrugated steel rebar commonly utilized for the onsite construction of the concrete walls and they feature yield stress rates ranging between 280MPa to 400MPa.

The Durability Characteristics of the ICF in terms of Energy Consumption Reduction:

- **Thermal Aspect:**
  Amongst the masonry used, concrete, especially the reinforced concrete, transmits the highest heat. Insulation is used to prevent heat transfer. ICF system does not pose much of a problem in this regard for its being composed of two polystyrene heat insulation

layers each of which usually 5cm in thickness. Also, the amount of air infiltration and heat exchange resulting thereof is trivial due to the use of appropriate sealing methods rendering the molds airtight. In such a system, the interior surface temperature of the wall is even due to the existence of an internal layer which is heat-insulated and there are not considerable thermal bridges in this system.

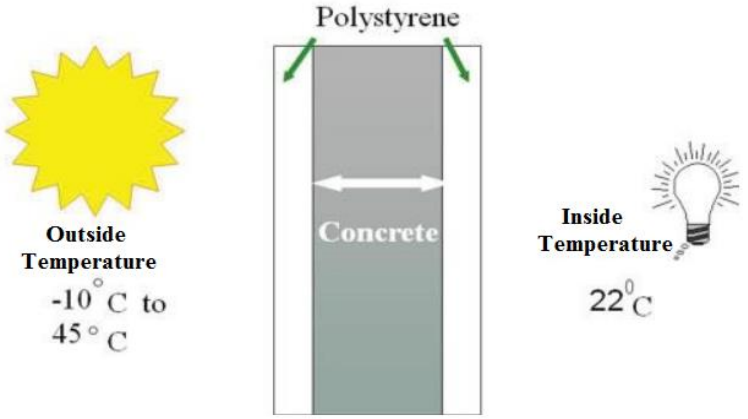

Figure 8: the method of heat transfer through the mold (source: quadlock.com)

Strength Aspect:

To investigate and compare the ICF and TCF resistance to fire, the strength rates of the concrete and the polystyrene insulation used in the ICF have to be taken into account.

- ✓ *Concrete's Resistance to Fire:*

  The various types of concrete used in this system are non-inflammable hence posing no danger. In its equilibrium conditions, concrete has a lot of moisture to exchange with the environment and retards the heat transfer to the inside upon the emergence of fire through losing moisture and dehydration reactions accompanied by the absorption of a considerable amount of heat. This is due to the high rate of latent evaporation heat as well as spending heat for dehydration reactions that considerably improve the concrete behavior against fire (Bahraminejad Maghou'eiyeh, 2011).

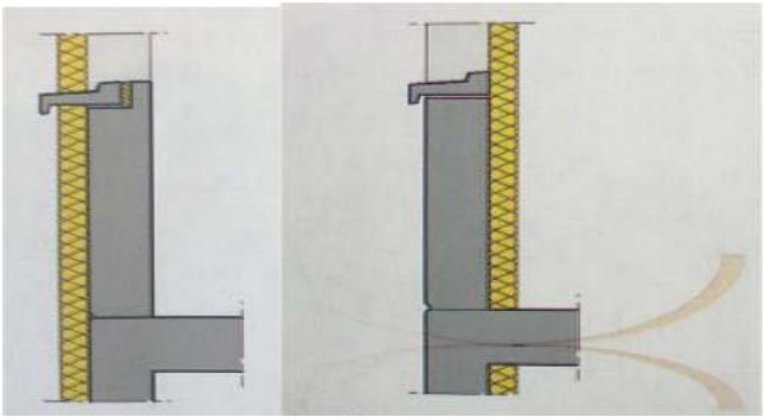

Figure 9: the role of mold in ICF

- ✓ *Polystyrene Sponge Resistance:*

  The polystyrene used in ICF should be in compliance with the credible standards and of the self-extinguishing or slow-burning type. Such a type of polystyrene will be shrunk upon being exposed to flame within a short period of time and retreats from the fire without catching fire. Due to the shrinkage of the insulation layer after being exposed to fire (temperatures close to 100°C), the gypsum board will break apart as a result of which the polystyrene will be directly exposed to fire for which reason the metal lath or mesh is used when connecting the gypsum board to the insulation layer. In case that these hints are observed in buildings wherein ICF systems are applied, the buildings will have very good resistance against fire.

- ✓ *The Effect of Moisture on Concrete's Resistance to Fire:*

  It is important to evaluate the effect of moisture on the concrete's strength. The moisture extant in concrete positively influences the concrete's resistance to fire if it does not exceed a certain limit and it can be stated generally that a one percent increase in the moisture volume causes an increase by 4% to 5% in the concrete's resistance to fire. But, any further increase in the moisture rate that depends on the cement porosity causes the development of cracks and fractures in the concrete upon its being exposed to fire (Muhammad Kary, 2008: 33).

  Since there is made use of polystyrene insulation layers on both sides of the concrete wall in ICF system in a permanent manner, the concrete has no possibility of rapidly losing its moisture content and the moisture is preserved in concrete for a long period of time. The concrete surface becomes hot when exposed to fire and this makes a layer located within a 2.5cm from the concrete surface to be saturated with moisture. Thus, the migration of the water vapor to the cold side of the concrete is prevented and this makes the water vapor pressure go up on this spot that will per se cause the concrete to lose its integrity and break. Some cases of concrete bursting have also been reported. After the concrete was broken, the concrete layer protecting the rebar intensively loses its thickness and the steel bars become exposed to fire and the mechanical strength of the whole system becomes degraded under fire emergency conditions due to the weakening of the steel bars in higher temperatures. Therefore, the extreme rates of moisture in concrete used in ICF system are not favorable and even risky (Bahraminejad Maghou'eiyeh, 2011).

CONCLUSION:

ICF system is amongst the up-to-date construction technologies on which a great deal of research has been conducted. Obtaining the ICF indices in rendering the studies more scientific and updating of the ICF construction techniques and implementation methods are deemed necessary. The use of novel construction systems within the format of the industrial production in such a way that they can be effective on energy consumption reduction is useful and needed in the markets of the country's construction industry. The industrialization of the construction does not necessarily mean the use of a system that is completely new and distinct rather the objectives

of such interventions are reducing the costs and increasing the speed and easing the construction operations.

The present article dealt with the exploration of the distinct and important ICF characteristics. The extraction of the results from the analyses and studies performed in this regard yielded the following conclusions: such a type of insulation enjoys a good deal of thermal insulation and can provide for the same extent of thermal energy saving and bring about reductions in the energy costs of a building to finally prevent the wastage of the natural resources and reduce the pollutions resulting from energy use in a national level. The industrial building construction implementation is essentially bonded to the prefabrication concept that incorporates the construction of the building constituting parts in the factory environment and transportation and installation and connection of them to one another in the final spot. In summary, prefabrication takes the followings as its purposes:

1) Energy (heating and cooling) savings up to over 75%
2) Bioenvironmental advantages
3) Heat, cold, humidity and sound insulation
4) Lower wastage of the constructional materials
5) The high speed of installation; the time is currently the most important factor in managing a project. Time can save an even uneconomical project and revitalize it and vice versa. One time-consuming part of the concrete structure is definitely formwork and reinforcement of concrete both of which have been revolutionized in ICF system and can be done within a short period of time.
6) Heightening the concreting quality; corresponding to journal no.55 of the Budget Management and Planning Organization, the formwork should prevent the concrete moisture lessening and leakage of the concrete sap and, in the meantime, protect the concrete against the climatic conditions. Such requirements have been met using different inter-mold connections and also via rendering the mold body insulated.
7) Being needless of the concrete form releasing agent; according to the technical provision enacted by the Budget Management and Planning Organization, the forms have to be cleaned after use and releasing agents should be applied on them. It has been seen unfortunately that the majority of the contractors use corrosive petroleum materials that cause the emergence of problems in concrete while the intended formwork method makes use of fixed molds for which no separating agent is required.
8) The feasibility of being implemented in regions inflicted with natural calamities; since Iran is a country that is prone to over 90% of the recognized natural accidents, the survivors can be accommodated within the shortest period of time in case that natural catastrophe comes about. Such a system responds well and in the shortest time to the accommodation problems of the survivors and it can be highly useful in eliminating the survivors' problems in terms of the environment's heat or cold.

The utilization of curing conditions appropriate for concrete inside the formwork is a factor that has been forgotten in concreting projects. Concrete curing is conducted after removing the forms and molds and even when the forms are still inside the work; based on the standards, the curing should last three days for ordinary concrete and seven days for concrete types featuring particular conditions like micro silica concrete. In the majority of the cases, the curing is undertaken in the workshops featuring standard conditions via creating artificial shade and use

of damp fabric. Such works usually do not end with proper output. Therefore, the ANISTA formwork system can be an appropriate environment for the proper curing of concrete due to the fact that the insulated form is left inside the work forever.

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