Numerical Evaluation of Soil Protection to Reduce the Waist of Energy around the Buildings

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Abstract - Among the various factors in building design, the style and form of the building can be effective in reducing energy consumption of buildings. Since it is obvious that before designing buildings the direction in which winter winds are often blowing from that direction is regarded and by designing and correct placing buildings the downwind exposed surfaces can be minimized. One of these ways is creating weirs or soil protection against the wind that makes the amount of influence of outside air reduced in connectors and roof. In this article we have studied the numerical role in soil protection by using the numerical model.

Keywords - Soil protection, Energy efficiency, Computational Fluid Dynamic.

I. INTRODUCTION

Taking appropriate and reasonable in addition to preventing the waist of valuable energy reserves, it also reduces the pollution and makes the environment healthier. It must be regarded that among the environmental pollutants, those that are derived from fossil energy over other forms of energy are causing environmental pollution. For example, reducing discomfort and respiratory tract infections, cough, headache, Increase the body's ability to work, reduce heart disease and blood circulation in humans, growing green leaves, plant growth and development and increased production in plants from the effects of reduced and destroyed sulfur and nitrogen and Carbon monoxide oxides that are the contaminants resulting from incorrect consumption of fossil fuels up to humans and plants (WEC, 2008, 8).On the other hand, the reduction and losing greenhouse gases and also acid rain which cause the loss of green areas and Species of plants and animals and warming the air of earth, is another sample of effects of correct using from fossil fuels, it is notable to know that a household energy for cooking during a year inserts 5/1 tons of greenhouse gases into the atmosphere or production of electricity of a refrigerator during a year adds 2 tons of greenhouses into the environment (Bakhshandeh, 1381,1).

Energy consumption in buildings of Iran is four times more in comparison with European countries. As it is observed in figure 1, residential and commercial part forms the most important energy consumers in country. This part has always had the largest share of energy consumption.

Energy consumption in residential part in 1346 was equivalent to 21.3 million barrels of crude oil that in 57 it increased to 61.6 million barrels and during this year it had the average annual growth of 11.21 percent. The growth in the 1357-67 periods because of the revolution and war was limited and had an average annual growth of 10.04 percent. In 1375 energy consumption in residential part was 231.4 million barrels that reached to 426.8 million barrels in 85 that its average annual growth equaled to 6.38. According to this in 85 about 45.8 percent of the energy consumption used in residential and commercial part (Shahmohammadi and cooperators, 1385,1).

As already mentioned, the construction sector is known as the largest consumer of energy in the country. Due to building technologies to optimize and save energy consumption can have a constructive role in a great extend in the subject. It is noteworthy that high consumption of energy never means comfort in buildings. The current dissatisfaction related to the lack of comfort backs to the location facilities like building's heating and cooling equipment. The buildings which have air handling systems and using higher energy consumption too are faced with the more grievances in comparison with the buildings that have no air handling systems. Although in many cases we use the buildings which contain multiple amount of energy, they don't provide multiple comforts. Therefore it begs the question that what are the factors affecting the efficiency and optimization of energy consumption? The main factors in this relationship are divided into three categories:

- Architecture building design
- Design of electrical and mechanical installations
- Resident's behavior

Studies conducted by Baker (1996) shows that the mentioned factors increase ten times the routine energy consumption. Building architecture contribution of energy consumption can increase 2.5 times the normal consumption and if we add the electrical and mechanical installations to that, the amount will increase twice, which means it will reach to 5 times the normal consumption. The share of residents in that case is the remaining ten, equals 2. According to the role of the architect as a designer of buildings in energy efficiency and reducing energy consumption it is necessary to investigate the heat exchange amount between the different sections of the building.

II.Architecture and optimization of energy consumption in buildings

It is pretty obvious that the effect of climate and weather conditions on the formation of the construction is counted in the elements of architecture limitations which has been considered by mankind as the shelter and by passing time and changing the styles and movements and definitions of beauty and art, and changing needs and attitudes and open spaces architecture, the main concept of this need also changed. On this basis, various stages of continental design can be divided in 5 parts:

1. Community and distribution of units
2. Determining the general physical structure of the building
3. Plan and view design
4. Landscaping
5. Designing the details of operational structure

The part 5 means the general physical of structure and implies organizing the general form and skeleton of a structure and the factors that this part is included in are: identifying the establishment direction of the building, the shape of structure (Outer surface ratio to useful volume), location of the building relative to the ground floor, form and the slope of the roof. Among the above factors, the posture and form building can reduce the energy waste in 2 ways. One way is the direction of sun radiation and the other is the direction of wind blowing. Furthermore the studies done by Amin Najafi (1366) shows that in a typical house with four sides open, rate of energy dissipation in the walls is 29%, roof 26%, flooring with outdoor 20%, openings 14% and the pores 11% (Tahbaz and cooperators, 1384, 1). Due to the 26% heat dissipation of the roof, the roofs form can be very effective optimizing the energy consumption of the buildings particularly in winter. Therefore the works that are done to promote the quality of buildings In view of the heat exchanger result in a considerable saving in the whole energy consumption in buildings.

III. Roof Form

Roof is a part of the structure which always saves the structure against atmospheric factors such as rain, snow, heat, sunlight and…. The roofs forms in different places are not the same and the most important about this difference can be found in the available materials and also climatic conditions of the region. We observe some examples of common roofs in Figure 1-A. Roof in the world's architecture has had a long history. The remaining structures from ancient period confirm this subject (Figure 1-B).

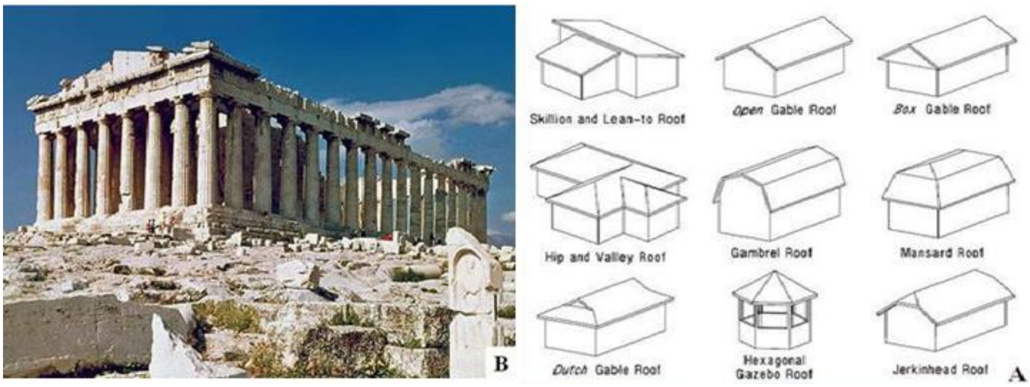

Fig 1. A-Common Types of Roofing B-Parthenon on the Acropolis of Athens

Roof in Iranian traditional architecture is also a part of life space and in addition to have complicated and beautiful volumes; it had been used as the yard. In cities because some structures are made from crate walls raised about 1.5 meters the side roof and create a kind of yard on the roof which had been used for sleeping in summer nights. Furthermore these walls by shading on a part of the roof in various hours of day had a second continental role too. Such spaces have also been used in mosques. In Sepahsalar Mosque above the ablution house that is called Chehel Shir, this space exists with the same shape. Another example is the house of Abasian Kashan which has the same yard on the roof that architects with subtle framing made from perforated bricks, provided the possibility to have ventilation too.

The other usages of roof in Iranian architecture are the construction of wind catchers on it in order to provide ventilation for the house (Figure 2-A).

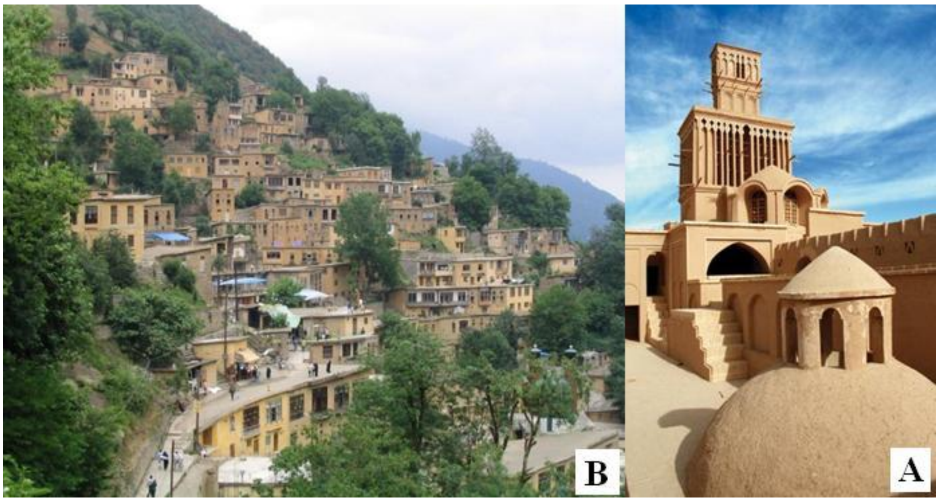

Fig 2. A-an Iranin windcatcher B-Masouleh city

Indeed wind catcher is an example of masterpiece engineering of Iran (Bahadorinezhad and cooperators, 1387, 15). Another amazing example of the roof in Iranian architecture can be observed in historical city of Masoule, the city in which the yard of the above building is the roof of the lower building (Figure 2-B).

To determine the roof form the critical condition like heat, cold and humidity and rainfall must be individually evaluated. In areas where cold air is a critical factor and the amount of rainfall and snow is high, as the snow itself acts as a good thermal insulation and prevents a large amount of waste heat energy to the interior of the building, it is necessary to consider the roof form in a way that in precipitation time, the snow remain on the roof and does not leak down. To serve the purpose it is necessary to predict a mild slope roof so that let the cold wind sliding pass easily through its top.
In areas where heat is a critical factor using domed or vaulted roof forms because of their special characteristics is suitable. Finally, in areas with high humidity and abundant rainfall are the main critical factors, the structure form must be provided in such a way that in addition to directing the flow of rainwater down, allow the winds combined with rain to pass easily from its top.

IV. NUMERICAL MODELING

There are 3 methods to solve problems related to fluid mechanics that include experimental method, analytical and numerical. The progress of numerical methods in various sciences over the past decades has been remarkable. .Due to the high costs of experimental methods and the weakness of analytical techniques in solving engineering problems, today most researchers have turned to the use of numerical methods. To achieve the airflow behavior around the soil protection, the geometry of the design using the existing maps, was drawn in Gambit Software (Figure 3).
As we observe in Figure 3 we have used two conditions of input speed and output pressure to solve the problem. Then we transferred the geometry to the fluent software. This software is based on finite volume method that is a strong and suitable method in computational fluid dynamics (Soltani and cooperators, 1386, 141).

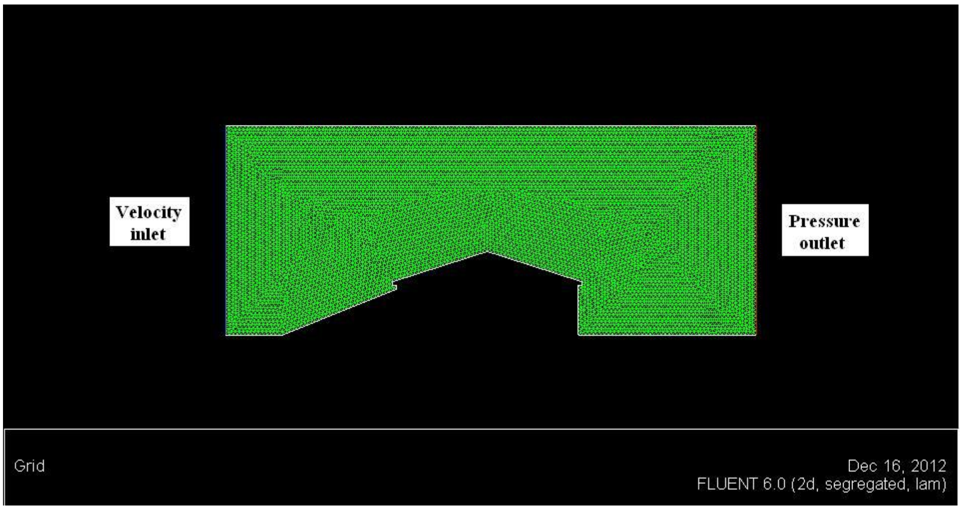

Fig 3. Geometric, meshing and boundary condition in model

In order to study the flow pattern around the building entrance speed is considered 10 meters per second. By solving the flow the achieved results are presented in Figures 4 to 7.

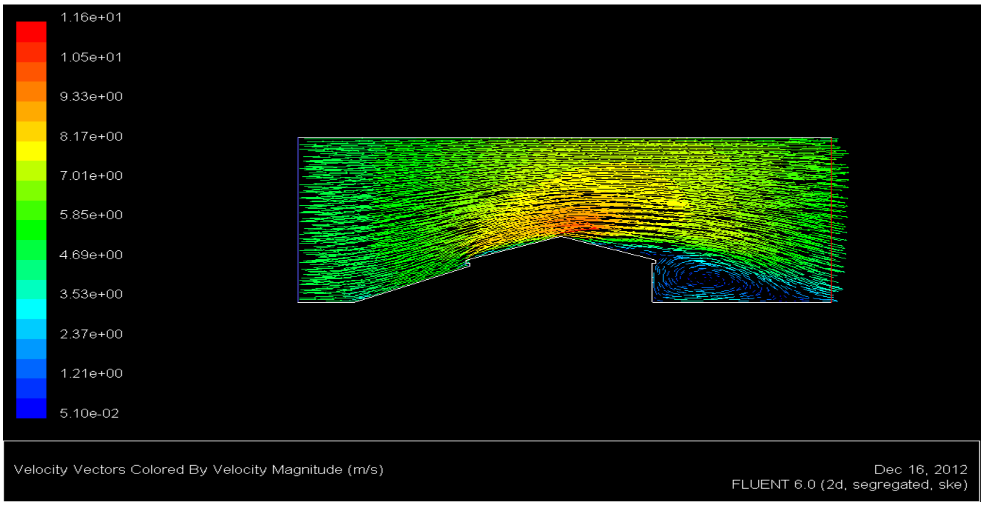

Fig 4. Velocity vectors around building

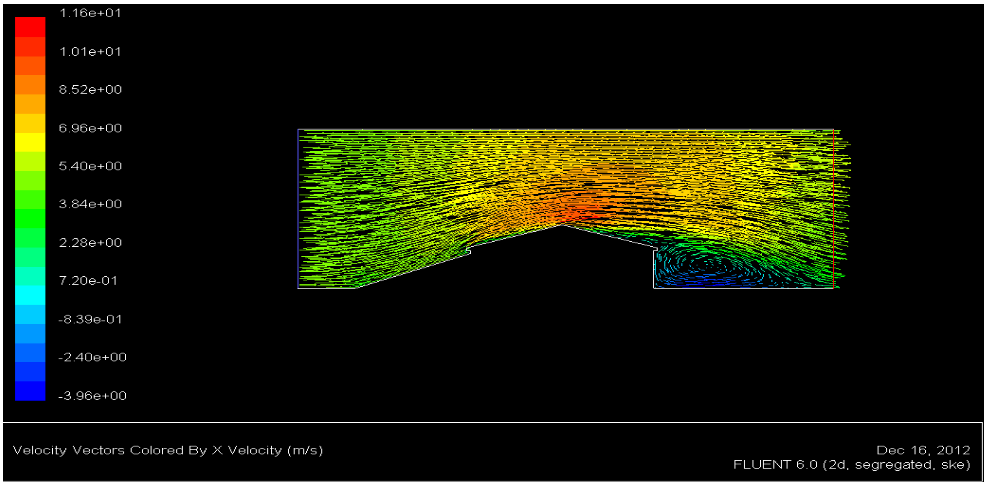

Fig 5. Velocity vectors in x direction

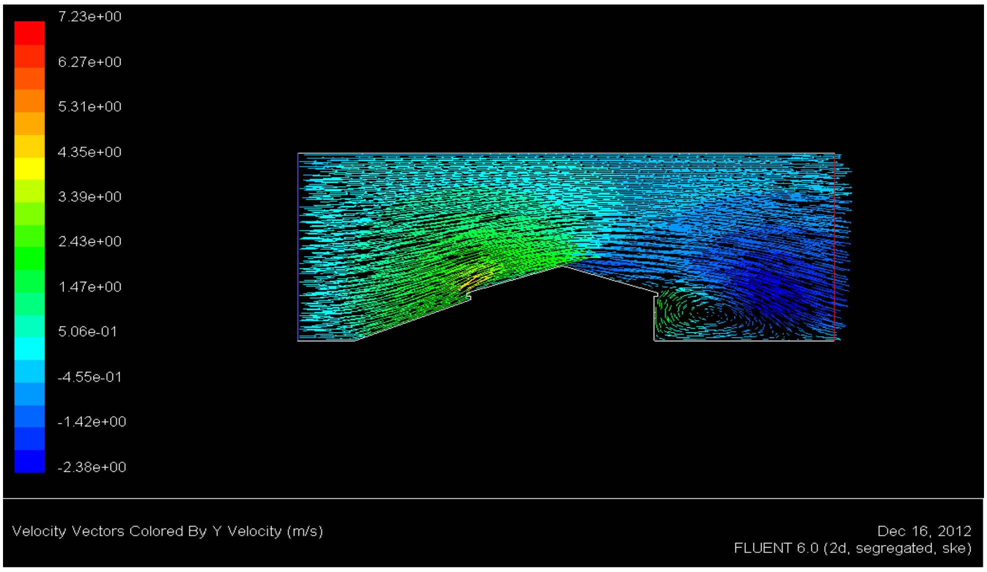

Fig 6. Velocity vectors in Y direction

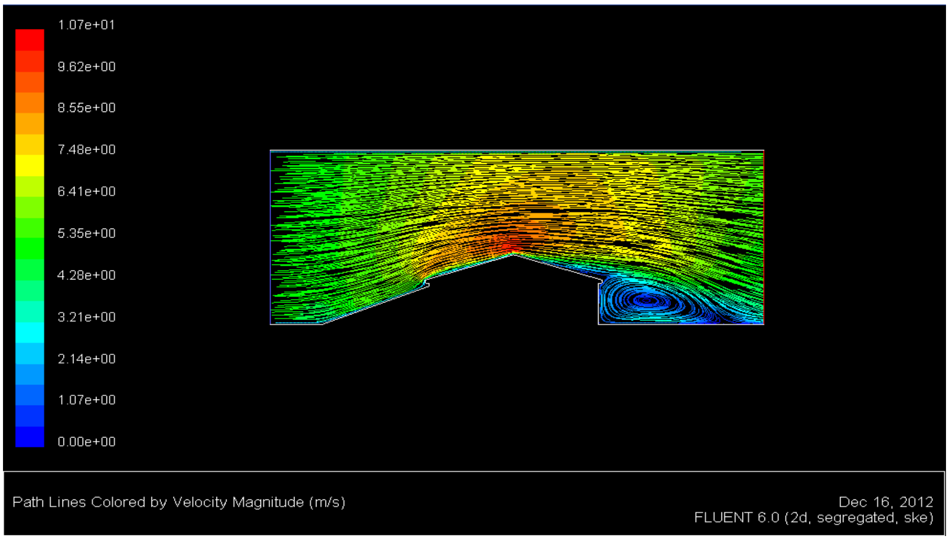

Fig 7. Flow pattern around building

V. CONCLUSION

According to the obtained results and figures in this study we can conclude that most velocity vectors in X direction, arisen in parts that there are more horizontal flow and the maximum amount of it occurred on top of the roof (Figure 5). The lowest velocity vectors for in X direction is also occurred around the building (Figure 5). Most velocity vectors in Y direction, occurred on top of the roof (Figure 6) and due to the wind gusts peed V=10 m/s speed in most parts of the building is less than this value (Figure 7). Furthermore according to the flow pattern obtained around these types of buildings (Figure 7) we can realize the suitable performance of these types of roofs in order to direct the air flow in a uniform manner and consequently the wind turbulence reduction in winter. According to the values and figures obtained it can be concluded that the Fluent software has a strong power to modeling the flow around the buildings and by using this software the parameters related to flow can be obtained in satisfactory condition.

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