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## FOURELEMENTS VS. FOUR ELEMENTS BY THE PURPOSE OF SUSTAINABILITY OF THE BUILT ENVIRONMENT

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### Abstract

*Wastes and pollution are recurring problems caused by the presence of various industries located in large cities. To solve these problems it is possible to create new cities based on industry. It is a known fact that the most severe damaging effect of industrial complexes are their pollutants that contaminate the air, soil, and water. Most of these types of pollutions are caused by fire. The ancient Iranian ancestors believed the simplest essential parts and principles upon which anything consisted were of these four holy elements, i.e. water, wind, soil, and fire ("char akhshij"). Methods of preventing industrial pollution for the purpose of "sustainability of the built environment" can be achieved by: (1) removing air pollution carried by wind, (2) the appropriate use of area (soil) for the industrial complex, (3) the industrial waste removal with the water, (4) the use of fire to convert the industrial waste to renewable fuel. The Mobarkeh Steel Complex (MSC) in Isfahan produces severe pollution in the city's (1) air, (2) soil, and (3) water. The case study in this essay focuses on the methods for reducing these pollutions with the use of elements described above.*

**Keywords:** Industrial town, Sustainability, Environment, Four elements

### 1. Introduction

Trend of industrial changes after industrial revolution, grew increasingly and resulted in more engagement of human in nature. As the result of these kinds of activities, a great volume of pollution entered the environment and damaged nature considerably. The traditional concept of the development that was about the economical growth was considered as the prominent concept in the world before 1970s. As the result, industrial countries exploited nature for more economical growth and this resulted in damages to nature that were not compensable (Abdoli, Sustainable Development of Energy, 1386, 2-5).

Artifacts influence not only on the ones who have made them, developed them, or dealt with them but also they are effective for the ones who are completely far from them. The modern problems and issues of the cities after industrial revolution including emission of greenhouse gases resulting from the fossil fuels, transportation and industrial wastes have detrimental effects on the environment and different aspects of human life. This issue necessitates the attempts for improving the urban life quality and environmental effects and its reflection can be seen in increasing number of journals of global conferences and research projects. Many of these reports have discussed more sustainable form and structure. Sustainable development as one of the main controversies of the world at the end of 20<sup>th</sup> century has influenced almost all aspects of human life and has been considered as a new idea in this era. From these reports, it can be concluded that in modern times, industrial parks are seeking for a comprehensive and sustainable development and it is believed that without environment protection, the development of industries is one-dimension and unsustainable.

Iran is one of the world countries with high level of population density. In forty years ago, industrial development has improved the life standards of the people in Iran to a high degree, but at the same time, has considerably damaged the environment. For this reason, Iran Small Industries and Industrial Park Organization has considered some policies regarding the environment to achieve sustainable development and has implemented some solutions and arrangements in all industrial parks (<http://isipo.ir>).

This is known that air, earth and water are influenced by detrimental effects of industrial complexes. Since Iranian ancestors believed that four sacred elements including earth, air, fire and water eliminate the pollution and evilness, so one of the solutions for preventing the industrial pollution with the aim of "the sustainability of the artificial environment" is using these main elements because nowadays, progress is attained by maintaining the old customs and this progress owes to history.

In this paper, firstly these four elements are introduced, their characteristics and the effect of pollution resulting from industrial complexes on them are dealt with and then some solutions are presented by correct localization in order to decrease pollution of these elements.

## 2. Literature Review

Sustainability idea as a legal standard is relatively new and was introduced to international law realm in 1992 (Steger & et. al., 2004, pp. 6-17). Many journals in global conferences and research projects (particularly WCED Brundtland in 1987 and CEC Green Report in 1990, Agenda 21 in 1993) have considered the more sustainable form and structure. For instance, 25 years ago, Agenda of Environmental Impact Assessment (EIA Agenda) presented some solutions for future as a tool (COM(2009)15) and Commission published a report in July 2009 and showed the efficiency of this report by explaining strong points of the EIA Agenda (internet database of Environmental Assessment). Taiwan is one of the countries that have taken some actions in this regard. In order to consider industrial garbage, Environmental Protection Administration (EPA) of Taiwan has been set up and has considered strategic plans including building, treatment, storage and final disposal systems, setting up a management centre of industrial garbage, and promoting recycling and reusing the industrial wastes and developed actively recycling and reusing the industrial wastes during year. Generally, in order to develop recycling and reusing the industrial wastes, EPA has take into account 14 items of industrial garbage for recycling and reusing the industrial wastes including paper, iron scrapes, coal ash, and other materials (Wei & Haung, 2000, pp. 93-95). In addition, in German Constitution (Grundgeset Art. 20 A), "Protection of Natural Foundations of Life" with the aim of responsibility towards future generation, some rules have laid down (Ulrich Steger and et. al., 2004, 6-17).



### 2.1 Four Elements

Iran ancient architecture has been designed based on the respect to natural elements including water, air, earth, fire, plant and other natural elements. For instance, using the energies that are not renewable and are basically adapted to nature causes no pollution. As an example, wind tower in traditional architecture of desert and placement of the buildings for using the renewable energy of air, or cat-walking system of the infrastructures for maintaining heat energy or the holes in gardens and basements which is a kind of climatic and heat property of soil. Nader Khalili is an Iranian architecture who has designed a system of soil and fire (Geltaftan) and has considered four elements of water, wind, soil and fire in the ceramic design of his house.

### 2.2 Sustainable Industry

By industrialization of Iran, new factories had been built based on the respect to four elements and for this purpose, the idea of factory garden was posed during first Pahlavi and texture factories were set up in big cities. Wool Industry Company of Esfahan is one of the factories that is located in Chahar Bagh e Bala Street (one of the historical streets of Esfahan) and in Zereshk Garden (one of the gardens of Safavai era). After this period, by industrial progress, nature protection in designs and industry was less considered. Recently, by emergence of the sustainability debate and sustainable development, these approaches have been reconsidered and the global reflection of this in industry can be regarded as one of the natural environment (<http://www.isfahan.ir/>).

### 2.3 Significance of the Problem

Limitation and quality of fossil energies and environmental problems are considered as the most important sustainable economical issues in the world. Pollutants resulting from wastes of factories and industrial parks and their consequences cause the world encounter with the reasonable and threatening changes. Increasing temperature of the earth, climatic changes and increasing water level are considered as one of these consequences. On the other hand, finishing the fossil sources and anticipating price increase, makes policy-makers suggest principles and policies for controlling the environment and makes scholars develop renewable sources with less pollution to be used instead of current energy system (Kazemi, 1384, pp. 2-4). However, Iran performance regarding the quality of water sources and sustainable energy has not been appropriate and regarding the air quality, Iran has had the weakest performance so that in 2008, of 149 countries, it has received rank of 68 in environmental performance. Iran is encountered with some problems such as loss of energy, air and water pollution especially in industrial parks and areas and mass production of garbage. Due to lack of attention to the environmental problems, Iran has annually suffered from more than 400 billion from an

economical viewpoint (ERIJD). Suitable climate and sunlight in more regions and more seasons of the year, low and high lands in the river paths, and some regions with high potential of wind provides Iran with an appropriate ground for using and developing new and clean energies but because using the renewable energies until two future decades will not be economical, so developing and mastering building technologies and finding a way for recycling the industrial wastes in Iran is of great importance as a future landscape (Kazemi 1384, pp5-7). Esfahan among Iran cities has the first rank of having a green space per capita. But in the recent year, pollutions resulting from urban transportation and industrial parks has increased so that according to the reports, during the last year, people of Esfahan, have breathed clean air only for five days and because Esfahan has nearly 7500 industrial units, according to the statistics in 1389, more than 2500 industrial units in Esfahan were assessed and nearly 1300 industrial units of these were pollutant. Because Esfahan is the biggest pole of steel industry in Iran (IMNA Newsbase) and nowadays, steel production is one of the parts with increasing growth and in processes of steel production, a great amount of factories' wastes is produced so that according to reports, is almost one tone of three tones of produced steel in steel garbage. This is not only a crisis of quantity but also is a threat for the environmental health (Huaiwei and Xin, 2000, 745-746). Therefore, considering the industrial steel complexes of in Esfahan is of particular importance.

### 3. Case Study: Esfahan's Mobarakeh Steel Complex

Mobarakeh Steel Complex is located 65 km south west of Esfahan and has an area of 35 km. It has been exploited in 1372 (Water and Energy Internet base of Sharif Industrial University).



Picture 1: Localization of Mobarakeh Steel Complex using Google Map



Picture 2: Position of Mobarakeh Steel Complex towards Esfahan

For implementation of the sustainable development, Mobarakeh Steel Complex has taken some actions for the environmental protection with the aim of preventing uncompensable damages resulting from industrial pollutants in material and spiritual dimension. So, this firm, from its foundation time until today, has done some projects that a part of them (in tables 1 and 2) is here considered (Internet database of Esfahan Mobarakeh Steel complex).

Table 1: Projects executed for the protection and preservation of the environment since Esfahan's Mobarakeh Steel Company's startup till 2001

Number of The Projects	Subject
39	Dedusting
79	Greenery
18	Lowering the Emissions
36	Measuring Instruments Pollution
41	Prevention of Water and Soil Pollution
3	Recycling And Reusing The Waste

Table 2: Names of projects completed or in progress since 2002

No.Expenditures in USD	Description
1.	Construction of the 3rd lake for collection and storage of treated wastewater
2.	Construction of lagoons for the collection of the oils produced during industrial wastewater treatment
3.	Projects for dedusting and removal of pollutant emissions in various areas
4.	Projects completed or underway for the expansion of the greenery
5.	Conducting research projects on waste recycling

#### 4. Methodology

Sustainable development of artificial urban environment with no consideration of sustainability standards in inside and outside of the city is not possible. Water, air, and fire are natural elements and nature and human life is based on them, in addition, they are the most necessary life foundations. Because renewable energies of water, air, sun and earth plays a key role in human life, entering these four elements into industry cycle is one of the modern themes in urban life and has caused many environmental problems that can be directed with correct localization of industries and city industries toward sustainable architecture.

GIS or Geographical Information System as a science of local information management can provide suitable tools for solving problems and complexities of good localization for the industrial decision-makers. Localization of industrial parks is a process where factors are determined and combined in a suitable mathematical model to determine a desirable place regarding to the kind of aims and activities. One of these factors is environment that include effective factors on air, soil and water (Shad and et al., 1388, 417-4180).

This paper is a field and library type and is based on the site observations. Presenting a solution by four elements is possible only by recognition of characteristics of these elements. Following diagram is the environmental assessment regarding the sustainability of artificial environment by categorization of these elements:



Picture 3: Environmental assessment via four elements

##### 4.1 Water

From early times, water in architecture, climates and different cultures has been regarded as an explicit symbol. Understanding the concept of water in architecture is dependent on the understanding the physical rules of water, act and reaction of water, and above all, the function, allegory and its relation to the human life. Since industrial pollutants are considered as one of the main pollutant factors of waters and have detrimental effects on environment and human health, protecting and cleaning water is of particular importance. Sustainable development of water resources as one of the issues of Agenda 21 has become the guideline of governmental plans (Ghiasvand, 1387, 2-5). Regarding natural water cycle does not change, it can be concluded that water resources for reusing, should be considered in relation to the sustainable development (architecture, 1388, 3-6). Therefore, the suitable orientation of industrial parks and their localization to underground water sources and surface water of cities is one of the ways to achieve sustainability. One of the arrangements of implementation is that industrial parks should be placed somewhere with proper slope (less than 5 degree) and should not be in the

flood path and or take pollution into cities. Also, by separating industrial wastewater from city wastewater, a great amount of pollution of water can be decreased. Creating basins for wastewater purification near industrial complexes including Esfahan Mobarakeh Steel Complex is one of the implementation solutions regarding this matter (Mortazavi and Poorang, 1379, 25-28).

#### 4.2 *Wind (air)*

Movement of the air is due to atmosphere pressure. Wind is the factor of heat exchange, humidity, transmission of particles and existing pollutions in the environment and cold from a point to other point and has an important role in comfort. From a climatic point of view, wind has quantitative characteristics (wind speed, wind orientation and wind frequency) and qualitative characteristics (purity of dust and purity of pollution). Localization of industrial parks by considering wind as an effective factor in displacement and transmission of pollution can be so that pollution is removed from city. One of the arrangements of implementation for this aim is suitable localization of industrial parks towards dominant wind so that pollution is moved to a place with no danger for environment and human life or to a place for cleaning dust and clearing. Even anticipation of wind turbines with renewable energy source like sun energy can be used for stability of artificial environment for controlling wind path if it is economical. Picture 4 is a proposed design for this solution.

#### 4.3 *Soil*

Soil is the basis of life, production and store of crude materials and plays a key role in human life. General role of soil is more important than that of air and water. The more people try to clean air and water the more they pollute soil and increase the pollution load of water (air filter dust, urban wastewater and ...). On the other hand, a great amount of soil is removed from its natural cycle and from agricultural area due to constructing building, roads and urban and industrial infrastructures and change into dead soil. Since soil is one of the natural and vulnerable elements and has lower self-cleaning than water and air industrial cities, it should be kept clean. For this purpose, some plans can be implemented in suitable localization are conducted for burying industrial wastes that are detrimental for soil. Also, reusing the soils mixed with less dangerous wastes containing rich materials can be considered in other sustainable development attempts of soil sources. (internet database of Environmental Research Institute). For this purpose, 41 projects concerning the prevention of water and soil of Esfahan have been conducted in Mobarakeh Steel Complex.

#### 4.4 *Fire*

In Avesta, the holy book of ancient Iranians, fire is the guardian angel of animal life and terrestrial fire is the cleaner and burner of evilness and sin. Fire is one of the four elements of life and is one of the dearest. Because burning the wastes and garbage is considered for cleaning the environment, fire can be regarded as the main element of the recycling process of industrial pollutants and returning them to the natural cycle. However, because combustion created by fossil fuels in industrial parks is the main factor in pollution production it can greatly decrease the pollution resulting from using the fossil fuel and to reach sustainability if sun energy is considered as a clean and renewable source of light and heat which are the characteristics of fire. Since, for the time being, fossil fuels are the main source of energy production in industries, correct localization of the industries regarding the dominant wind is of particular importance because wind can direct the smoke of combustion to the residential regions and other cases that were discussed in the wind section.

### 5. **Conclusion**

Industrial parks are the forgotten regions in the sustainable development projects while they have the most impact on the environment. Sustainable development with environmental approach with no consideration of the correct localization of the industrial parks is not complete. Therefore, in this paper by studying sustainability it was concluded that localization of industrial parks based on four elements of water, wind, soil, fire in preventing the environmental pollution has a great impact and can considerably decrease the pollution rate resulting from industrial wastes on cities and the environment, it can also meet the need of industrial parks after exploitation to the strategic solutions and new technologies for decreasing the pollution, those that are not economical and using them has the environmental consequences. All industrial fields need a great deal of energy and different forms of energies. In some industries including factories of chit sazi, stained glass, dyeing, cement production, lime furnaces, factories of steel melting, steel industry and food industries are used for heat production and in some industries are used in the form of propulsion for setting up engines and machines in factories and for setting up engines of vehicles for transporting the productions and finally they are used as crude materials in chemical fertilizer industries. Using the sun energy for energy production although is appropriate for residential

users but in industry due to breadth of required energy, is not economical till two future decades but government can cause the absorption of investment in various regions and more development of these regions with localization of industrial parks in different regions of the country and by providing the safe environment for investment (shie, 1388). Sustainability approaches in localization of industries and environmental approaches can create life expectancy in a healthy environment for future generation.

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