Int. J. Architect. Eng. Urban Plan, 28(1): 105-115, June 2018

DOI: 10.22068/ijaup.28.1.105

Sustainable Architecture Environment

The Significance of the Priority of Applying the Parameters of Sustainable Development in Combined Cycle Power Plant Design

P. Hessari[1], M. Zandieh[2,*], I. Mahmuodzadeh Kani[3]

[1]PhD Candidate, School of Architecture Imam Khomeini International University (IKIU), Imam Khomeini International University (IKIU), Qazvin, Iran

[2]Associate Professor, Imam Khomeini International University (IKIU), Imam Khomeini International University (IKIU), Qazvin, Iran

Professor, Tehran University School of Civil Engineering, University of Tehran, Tehran, Iran

Received: 3 April 2017, Revised: 5 January 2018, Accepted: 20 January 2018, Available online: 28 January 2018

Abstract

Power plants with complex technology have various gradations in design process so that this level in the current time by maintaining the goals of sustainability and sustainable development have a critical importance. These buildings require to be sustainable according to their complexity to provide the finance and discrete budgets for functional needs, meanwhile to design solutions to avoid creating pollution and the reduction of energy should be careful and they are in their life cycle which have a social function. These solutions are possible to offer providing a method in design. Focusing on interventional and unique procedures in design can be very efficient. The present research is applicable with the aim to emphasize and recognize the importance of prioritizing in selecting different areas in combined cycle power plants based on the parameters of sustainable development and responds to the question on what priority should be set in the areas of combined cycle power plants,while observing the principles of sustainable development in the direction of control and decrease of economic, social and environmental risks, describes the infrastructures of sustainable development in the areas of combined cycle. Therefore while addressing senior managers, advisors and contractors ,has presented a list with the consultation of the experts and in the second stage through scrolling using questionnaire and survey from experts and AHP software analysis among consulting companies managers, contractors and professionals the criteria were prioritized in hierarchical method. The economic-functional criteria with rank 0.541 have been in the first priority of attention form the experts' choice and considering the effect of these criteria on the choices, the choice of steam in combined cycle power plants was placed in the first priority with final weight 0.313 and the gas area was determined in the second priority with final weight 0.266. This was also true in the sensitivity test. Thus paying attention to the functional criteria in order to gain economic productivity in the steam area was defined in the priority of attention.

Keywords: *Sensitivity analysis, Sustainable development, AHP, Performance, Combined cycle power plant.*

1. INTRODUCTION

Combined cycle Power plants are significant as one of the subdivisions of thermal power plants. The reasons why combined cycles are more and more popular and being taken under consideration as one of the main types of power plants are completely varied. The main reason is efficiency. Nowadays, combined cycle power plants can achieve more than 60% efficiency what makes them one of the most efficient one [1].

** Corresponding author: Mahdi_zandieh@yahoo.com*
Tell: +9828133780051; Fax: +9828133780072

In designing the combined cycle power plants, design is made based on a fixed process so that the productivity can be maximum. The proven design for:

- High efficiency
- Superior reliability and availability
- Controlled capital costs
- Rapid implementation
- Environmental compatibility
- Operational flexibility [2]

This productivity includes an outlook to the parameters of sustainable development in economic, environmental and functional fields.

In today's world, the principles of designing have to be in the direction of supplying the benefits of sustainable development which it holds a special classification.

Sustainable development activities are related to construction and created environment, sustainable building or structure are often called stable. The building sector is one of the greatest social and economic sectors in Europe and by created environment, significant changes in the natural environment are effective. Construction and created environment, as two key areas of global sustainable development, are discussed. Due to comprehensive solution to the challenges of sustainable architecture and environmental considerations, however, to get the level of quality of life and cultural, economic, social values and welfare are of great importance [3].

In this research, the main criteria are the same as components of sustainable development.

In designing combined cycle power plants, these components have changed. In fact, economic stability depends on proper function of suppliers to provide stability, human performance needs and security.

In the present paper, the focus is on how to respond to the prioritizing of combined cycle power plants areas, while observing the principles of sustainable development with the aim of emphasizing and recognizing the importance of prioritizing in choosing different areas in combined cycle power plants. In general, the process of this research is done in the following order with the supposition of the significance of environmental issues in the priority of designing combined cycle power plants while considering the literature of research.

- Studying the literature of issue with the aim of knowing the ground of plan with theoretical studies
- Inquiry from the related experts and analyzing the opinions statistically by using the hierarchical method and analyzing using expert choice software
- Analyzing data and the desired output with the view of the majority of experts in order to reject or prove the hypothesis
- Future Suggestions

2. LITERATURE

Sustainable development is a concept that is very vast and has many different meanings, and the meanings of the frequency response of various expert's dispose. The concept of sustainable development is an attempt to combine the concepts of the growing field of environmental issues, social issues and economic prosperity. In this regard, sustainable development and environmental, social and economic strong issues are linked each other [3].

The beginning of the modern sustainability movement in the United States was along with the environmental movement of the 1960s. Books such as, Rachael Carson's Silent Spring, made the public more aware of the dangers which they encountered with industrial and agricultural toxins and pollutants. Several years later, in 1972, the United Nations held the Conference on the Human Environment in Stockholm, Sweden to discuss environmental concerns. Following this conference, several national and international organizations such as the United Nations, formed Environmental Program. Their work in the 1960s and 1970s environmental movement laid the groundwork for the concept of sustainability. In 1987, the United Nations World Commission on Environment and Development report, Our Common Future created the definition of sustainable development that is most often used by the building industry [4]. What follows is among the studies made in combined cycle power plants.

- In a study performed in 2008, one can refer to (Environmental, Health, and Safety Guidelines for Thermal Power Plants), In the present study, the issues of sustainable development are expressed in detail and special way:

The Environmental, Health, and Safety Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice. When one or more members of the World Bank Group are involved in a project, these EHS Guidelines are applied as required by their respective policies and standards. These industrial sector EHS guidelines are designed to be used together with the General EHS Guidelines document, which provides guidance to users on common EHS issues potentially applicable to all industry sectors. For complex projects, using multiple industrial sector guidelines may be necessary [5].

- In environmental field, another study holds other view:

Environmental issues in thermal power plant projects are primarily as follows:

- Air emissions
- Energy efficiency and Greenhouse Gas emissions
- Water consumption and aquatic habitat alteration
- Effluents
- Solid wastes
- Hazardous materials and oil
- Noise

Prioritizing power generation method according to the components of sustainable development research has been done using hierarchical methods, such as that of Ahmet Sarucan [6].

- In a study titled (The efficiency analysis of different combined cycle power plants based on the impact of selected parameters) in 2016 on effective parameters on the efficiency of combined cycle power plants [1].

In present study, three different combined cycles were modeled in the Gate Cycle software: single-pressure with supplementary firing, dual-pressure and triple-pressure reheat cycle. Ambient temperature, pressure ratio in the gas part and temperature at the inlet to the gas turbine were investigated as the most significant factors which affect on efficiency and power production in whole system .

- Eskom holding in a study in 2017 titled (Environmental Impact Assessment Process: Final Scoping Report for the Richards Bay Combined Cycle Power Plant (CCPP) and Associated Infrastructure near Richards Bay) with the emphasis on environmental issues in combined cycle power plants.

The purpose of the project is to reduce transmission losses from generation facilities supplying KwaZuluNatal, by having a generation center in KwaZulu-Natal. In addition, the project is planned to aid in reducing Eskom's

carbon footprint per unit of electricity produced, as power plants using natural gas emit approximately half the carbon of coal-fired power plants while using considerably less water, thus supporting Government's commitment to reduce carbon emissions [7].

- In a research done by Iberdrola in 2017, the findings presented as follows which are again about the environmental issues.

Identification and assessment of the environmental matters arising from energy production. Every significant environmental aspect has an associated operational control procedure, known to all company staff and to everyone working on behalf of or for the company.

Identification and response to emergency situations through the establishment of a "Self-Protection Plan" and "Emergency Environmental Instructions (in Spanish, IMAE)".

Identification and evaluation of compliance with environmental legislation applicable to combined cycle plants. The identification of training needs and completion of the actions required to satisfy them, in order to promote greater environmental awareness among staff.

The establishment of environmental objectives and goals, approving an Environmental Management Program, which defines the deadlines, resources and people responsible for achieving them.

The establishment of a procedure for communication among all levels and positions in the organization, and by all external stakeholders.

The establishment of an internal audit program to verify that SIGEC is kept up-to-date, is effective and complies with the implemented standards [8].

Many studies have been done in relation to sustainable development and in all cases, they have been looking for ways to survive the three components of sustainable development. In relation to prioritize the spaces to focus on sustainable design in combined cycle power plants, there has not been done much until now and in this regard, this is a unique and practical research.

Article refers to many cases of past research. Also about the way in which construction sustainability can be ensured, there are many general articles which can be noted in the following table Table 1:

Table 1 Research background

Researcher	Year	Research title	Subject	Research context	Results
Butera [9]	2010	Climatic change and the built environment	Compared resources and energy consumption structures	Cities in developing and developed countries	In order to improve the efficiency of building performance, sustainable design solutions should be differentiated in developing and developed countries.
Seunghwa and Kim, [10]	2015	Bim -Based Quality Control for Safety Issues in the Design and Construction Phases	Including safety management quality control, has emerged as an efficient solution because it can support human decision-making and evaluation.	-	Safety management and issues Safety review by using Building Information Modeling
Lim, [11]	2015	Building Information Modeling for Indoor Environmental Performance Analysis	An essential role in collaboration among multi-discipline professions	-	BIM-based sustainability simulation during early or pre-design stage is very crucial to develop sustainable building design

Thermal power plant is electricity generation plant which converts the fossil fuel stored energy to electrical energy by means of generating electricity. In other words, it is merely a chain of Energy conversion as follow:

- Chemical energy in the fuel is converted to Heat energy of steam.
- Heat energy of steam is converted to Mechanical or rotating energy of a rotating wheel called Turbine.
- The mechanical energy of Turbine is converted as Electrical Energy in a Generator [12].

Thermal power plants are divided into two types: Gas power plants and Combined Cycle Power plants.

Combined cycle is defined as a system composing two thermal cycles. In such a system, the efficiency of both parts is higher than when they work separately [1].

The different types of systems and components used in steam power plant are as follows:

1. Coal handling plant
2. D.M. plant
3. Boiler and furnace
4. Turbine and Generator
5. Transformer and switch yard
6. Ash handling plant
7. Cable gallery
8. Fuel Storage Tank / Pump House/Batter [12]

The difference between combined cycle power plants and gas power plants is that in the gas power plants, the procedure is in gas cycle but in combined cycle power plants, gas is accompanied with vapor. The heat exhausted from gas turbine creates the temperature needed producing steam. The produced steam is used to move the steam turbine impellers. In these power plants, dry or wet cooling system is generally used to cool the water caused by the condensation of the steam coming out of steam turbine.

In general, this study performs the stages of sustainability based on the classification caused by Menanco studies [13]. Of course some other zones as the zone of fuel, water treatment, firefighting, auxiliary, maintenance and equipment services also exist in this classification of important zones were studied based on the view of the experts.

- **Gas Zone**: This Island is in fact the biggest and the main part of the gas zone. The island of power block

consists of the building of turbines, equipment and the buildings around it.
- **Steam zone**: This Island is in fact the biggest and the most major section in steam zone in combined cycles and customary steam power plants. The island of power block includes the turbine hall and auxiliary equipment.
- **HRSG zone**: This Island is related to producing steam for steam turbines in combined cycle power plants located in adjacent to the building of steam turbine.
- **Cooling zone**: This Island consists of main cooling system and auxiliary cooling system.
- **Office zone**: This zone consists of administrative and support buildings.

In the process of this article, the effect of sustainable development criteria in a context such as the combined cycle power plants, in order to choose a space that has more capabilities and focus on design is as follows:

2.1. Functional - economic criteria: optimized and more appropriate performance from economic point of view

By interpreting the above-mentioned background, one of the criteria of the sustainable development is the economic criteria and in realizing this balance, all the available capacities must be used to gain economic productivity. Thus, the functions available in one usage are correctly defined. What is desirable here is an integration of economics and function in order to provide safety and security, observing regulations and standards, stability, decrease in the costs for changes after operation, choosing the best technology of equipment, economic productivity with the estimation of time and costs and choosing the best technology production with optimal economy.

2.2. Social criteria: The proper functioning for human activity and also aesthetic and semantic issues

As the power plant architecture mostly focuses on suitable function rather than to the possibility of using historical-social signs and meaning in the building, thus considering the objectives of sustainable development, direction of human activity and need to change is necessary in order to realize the social need.

2.3. Environmental criteria: Lack of production of environmental pollutants and also reducing fuel consumption

The option of paying attention to environment is one of the criteria which discussed in all researches with great emphasis. Choosing the best technology of equipment in the direction of reducing pollutants production and in the direction of increasing productivity and power production also choosing the best technology of production for the purpose of preserving natural resources: recycled materials, energy reduction and so on are among the components which significantly discussed in combined cycle power plants.

3. RESEARCH METHOD AND RESULT

A method of data analysis in this research is based on AHP model. In this sector of this paper, while explaining this model, it will be described how to use it.

3.1. Analytical hierarchy process

The Analytic Hierarchy Process[4] is a multi-criteria decision making[5] method that helps the decision-maker faces a complex problem with multiple conflicts and subjective criteria (e.g. location or investment selection, projects ranking, and so forth) [14]. The decomposition of research objects into individual factors which has different levels due to the nature of research objects is the main conception and the first step of AHP. In the second step, a hierarchical decision system according to specific procedures is made by their dominance relationship. The weights through distinct indices are fixed by doing pairwise comparisons at the same level. Then different objects are placed in an order. The magnitude of the weights and characteristics of various objects are compared and it is resulted in a good judgment. Three steps in AHP, decomposition, judgment and synthesizing are the same way as people think. So it could be said that AHP is a subjective weighting method. The relative importance between two comparative factors is reflected by the element values of judgment matrix. Table I shows general form of the measurement scale. It has relative importance in scale of 1-9 [6, 15].

3.2. Creating hierarchy

At this point, the problem is defined Fig. 1, while the decision and the purpose of decision-making as hierarchy of the constituent factors and elements are drawn. Analytic Hierarchy Process requires breaking the determined problem into a hierarchy of levels by several indicators. For this purpose, a decision tree is used which composed of three levels: The first level of decision making includes the general purpose. At the second level, there are the general criteria which decision making can be based on them. At the third level, there are options. The following figure represents the hierarchical structure of priority of choosing suitable space. A typical simple decision hierarchy involves a goal, criteria or objectives and alternatives of choice, see Fig. 1. We make judgments on the elements of the hierarchy in pairs due to their parent element to derive priorities and then synthesize the priorities into an overall result. The Expert Choice software is based on AHP and offers a systematic framework where we can lay out the elements of the problem in a hierarchy, enter judgments, and derive priorities for action. It engages decision makers in breaking down a decision into smaller parts, proceeding from the goal to criteria to sub-criteria and so on down to the alternatives of action. In making the judgments, the elements of the problem are looked in isolation: one element compared against another due to a parent element. Then decision maker makes only simple pairwise comparison judgments throughout the hierarchy to derive the priorities of the elements [16].

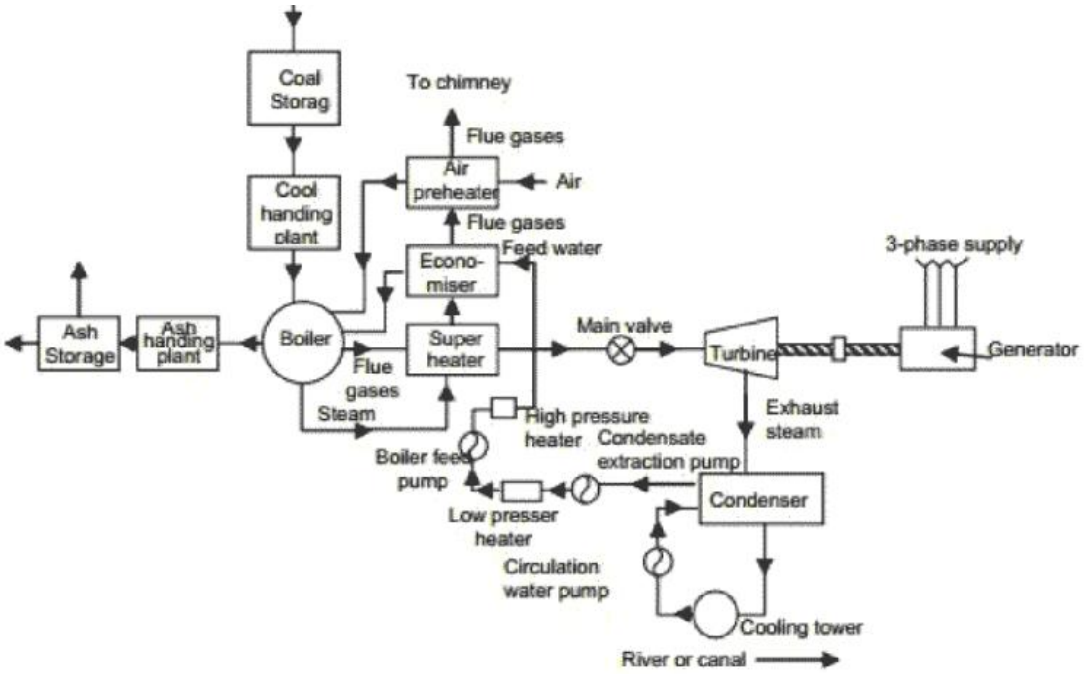


Fig. 1 Block diagram of thermal power plant [12]

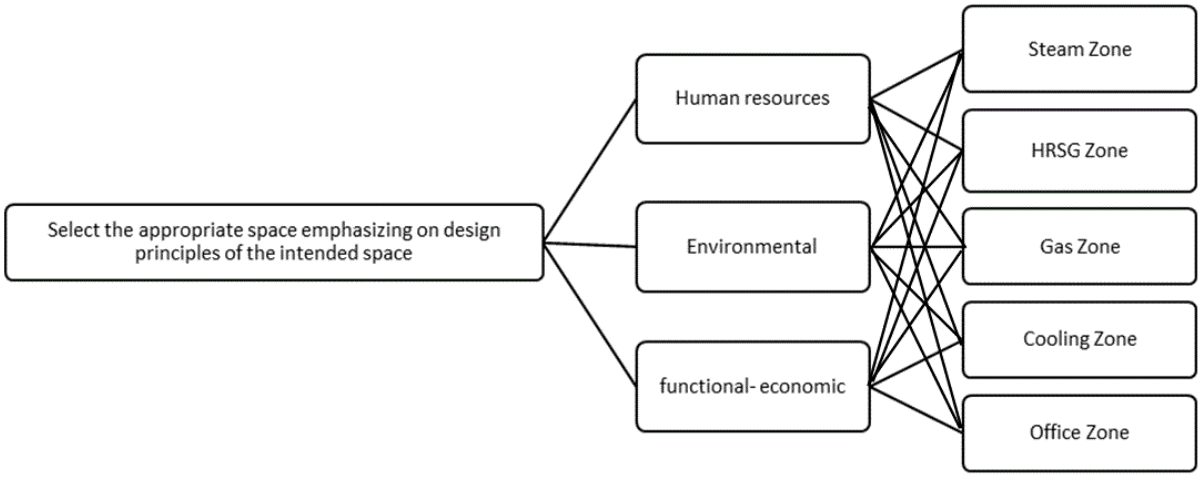


Fig. 2 Tree diagram of AHP

At this stage, the experts do the comparisons between criteria and alternatives and determine their rates relative to each other. These criteria are compared based on the table of nine quantities. Preference table is an option or agent for the action of which to itself which is equal to one. Therefore, pairwise matrix has two main characteristics inverted principle of a factor than the other and preferred to compare an agent or option than itself. These two characteristics cause the n criteria or option Table 2, the decision maker only answers n(n-1)/2 questions.

Table 2 Scoring the expert questionnaire [6]

Importance degree	Descriptions	Explanation
1	Equally important	Criteria *i* and *j* are of equal importance
3	Weakly important	Criteria *i* is weakly more important than objective *j*
5	Strongly important	Criteria *i* is strongly more important than objective *j*
7	Very strongly important	Criteria *i* is very strongly more important than objective *j*
9	Extremely important	Criteria *i* is extremely more important than objective *j*
2, 4, 6, 8	Intermediate values	For example, a value of 8 means that Criteria *i* is midway between strongly and more important than objective *j*

This sector of paper aims to select superior space in terms of components of sustainable development in order to provide it based on methods and predictable methods using relevant documentation related to sustainable development, firstly an effective factor in sustainable development was raised in general. In a survey of experts in the fields of industrial buildings construction (the contractor, the designer and the employer), options overall spaces in buildings combined cycle power plants was done by experts using a questionnaire hierarchical structure and priorities Table 3.

Table 3 Detail of the studied population

Education	The purpose approach	Number	Statistical population
PhD (architecture, project management, executive management, civil, mechanical, electrical)	Theoretical principles and fundamental	9	University professors
BA to PhD	Executive and professional	9	The main contractors and managers
BA to PhD	Fundamental and professional	9	Design group (architectural, structural and MEP)

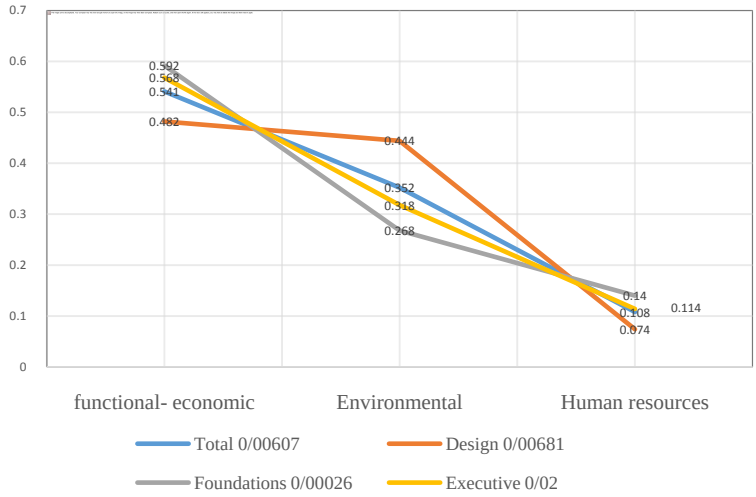


Fig. 3 Pairwise comparison of main criteria

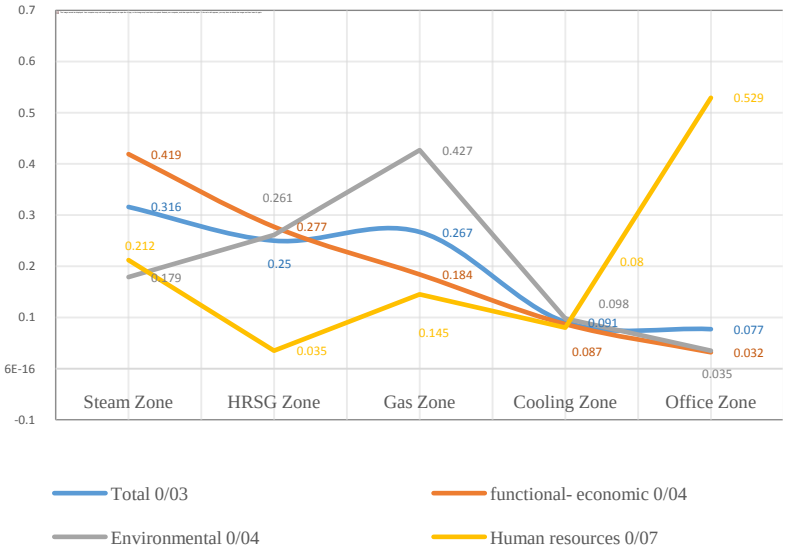


Fig. 4 Pairwise comparison of alternatives

When CR≤ 0.10, it means the consistence of the pairwise comparison matrix is acceptable [6]. As can be seen in the above charts, in all cases the incompatibility coefficient is smaller than 0.1. Hence the more it is closer to zero, the higher the accuracy of the responsiveness. This analysis is done by expert choice software.

The last step of the decision process is the sensitivity analysis, where the input data are slightly modified in order to observe the effect on the results. If the ranking does not change, the results are said to be powerful. The sensitivity analysis is best performed with an interactive graphical interface. Expert Choice allows different sensitivity

analyses, where the main difference is the various graphical representations [14]. The weight of the criteria has a big influence in the rank order of the alternatives. The decision maker must know the degree of reliability of the results in order to be able to make the final decision. Therefore, a sensitivity analysis is recommended to be used once the global order of alternatives has been obtained. It consists of calculating again the rank order of the alternatives but by modifications in the weight of each criterion. By helping software EC 2000, a complete sensitivity analysis can be performed. The way to do is to increasingly or decreasingly modify the weight of each criterion little by little while the rest of the criteria weights remain fixed. In that way, the contribution of each criterion to the value of the alternatives may be analyzed. After proceeding with the sensitivity analysis, the alternatives ranking may change. The analysis of all the possible changes can be done by helping Expert Choice 2000, which has a very powerful and user-friendly sensitivity analysis module [17].

To perform this function, while the other weight of criteria remained constant, weight of a criteria is incrementally increased or decreased. After sensitivity analysis, ranking of the options may be changed. The analysis of all the changes may be done by expert choice software.

The sensitivity analysis in Expert Choice varies the weights of the criteria as input data. It is also imaginable to have a sensitivity analysis in the future by interactively varying the local priorities of the alternatives (there is no mathematical challenge in it). However, sensitivity analysis is a fundamental process in the decision with AHP; it has received little attention from the academic literature [16].

There are five types of analyses: Performance Sensitivity, Dynamic Sensitivity, Gradient Sensitivity, Head-to-Head Sensitivity, and Two Dimensional Sensitivity [18].

3.3. Performance sensitivity

Fig. 4 shows the screen-shot of the performance sensitivity graph. It displays how the alternatives (Steam Zone, Gas Zone, HRGS, Cooling Zone, and Office Zone) perform due to all three main criteria. Dragging the criteria bars up or down can temporarily alter the relationship between the alternatives and their criteria.

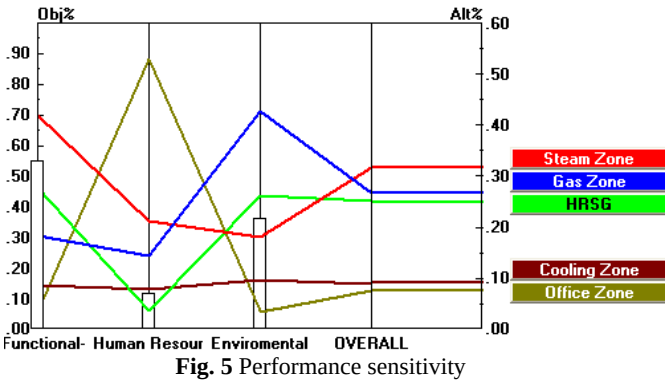


Fig. 5 Performance sensitivity

3.4. Dynamic sensitivity

Fig. 5 shows the screen-shot of the dynamic sensitivity graph. It is used to dynamically change the priorities of the criteria to determine how these changes affect the priorities of the alternative choices. By dragging the criterion priorities back and forth in the left column, the priorities of the alternatives will change in the right column. If the decision makers think a criterion might be more or less important than originally indicated, the criteria bar can be dragged to the right or left to increase or decrease the criterion priority, and the effect can be seen on the alternatives. For example, as the priority of one criterion decreases (by dragging the bar to the left), the priorities of the remaining criteria increase in proportion to their original priorities, and the priorities of the alternatives are recalculated [18].

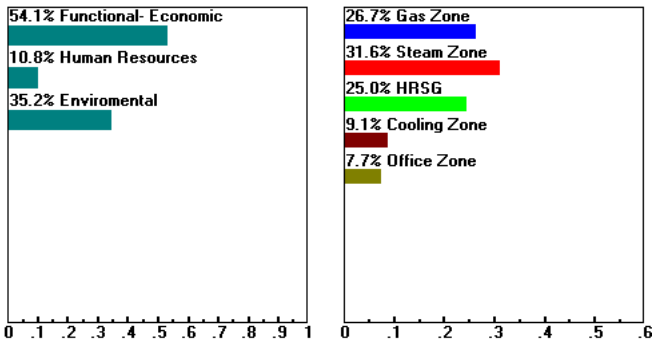


Fig. 6 Dynamic sensitivity

3.5. Gradient sensitivity

Fig. 6 shows the screen-shot of the gradient sensitivity graph. This graph shows the alternatives' priorities one criterion at a time. The vertical solid line represents the priority of the selected criterion which is read from the X-Axis intersection. The priorities for the alternatives are read from Y-Axis. To change an objective priority, drag the vertical solid bar to either the left or right. Then, a vertical doted bar showing the new objective priority will be displayed.

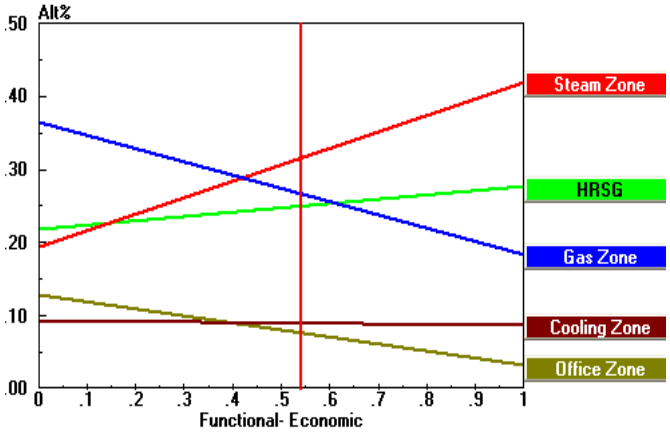


Fig. 7 Gradient sensitivity

3.6. Head-to-head sensitivity

Fig. 7 shows the screen-shot of the head-to-head sensitivity graph. The graph shows how two alternatives compare each other against the criteria in a decision. The middle of the graph lists the criteria used in the decision. In this example, the two alternatives are gas zone and steam zone. The overall result is displayed at the bottom of the graph by a horizontal bar, and it shows the overall percentage. In this case, the steam zone is better gas zone.

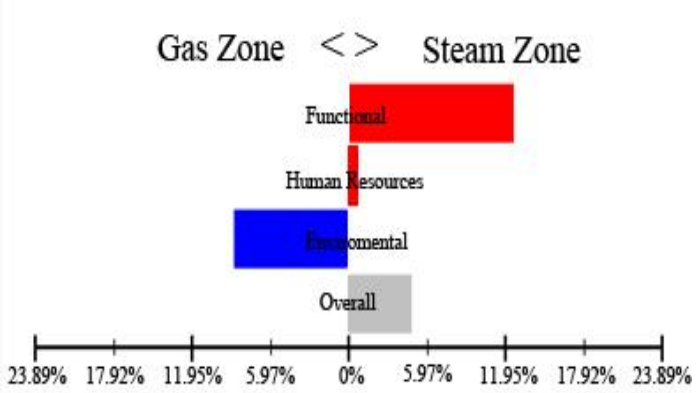


Fig. 8 Weighted head-to-head between gas zone and steam zone (Sensitivity)

3.7. Two-dimensional sensitivity

Fig. 8 shows the screen-shot of the two-dimensional sensitivity graph. This graph shows how well the alternatives perform due to any two criteria. In this example, the functional-economic sample is represented on X-Axis and human resources is on Y-Axis. The alternatives are represented by the circle. The area of 2D plot is divided into quadrants. The most favorable alternatives, as defined by the criteria and judgments in the model, will be shown in the upper right quadrant. While instead, the least favorable alternatives will be shown in the lower left quadrant (Gas Zone, HRGS, and Cooling Zone). Alternatives located in the upper left and lower right quadrants indicate key tradeoffs where there is a conflict between two criteria (Steam Zone and Office Zone).

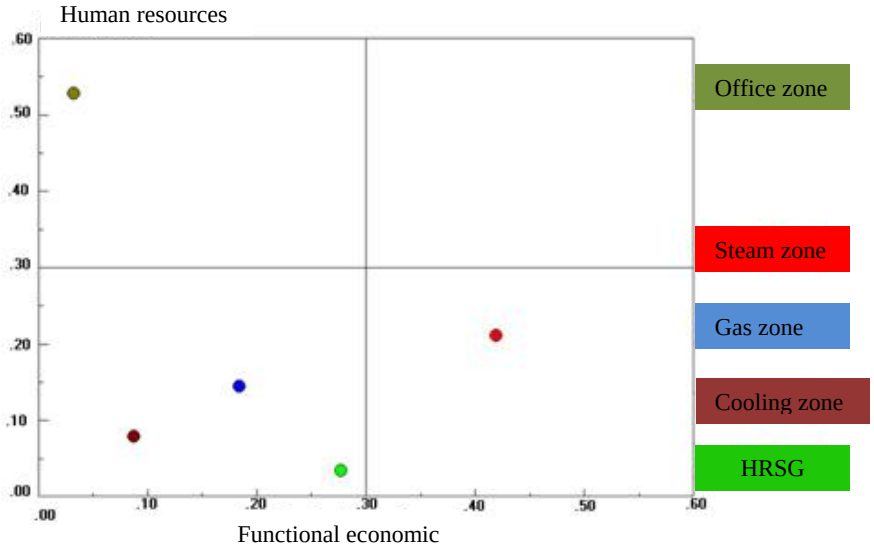


Fig. 9 Two-dimensional sensitivity

4. DISCUSSION

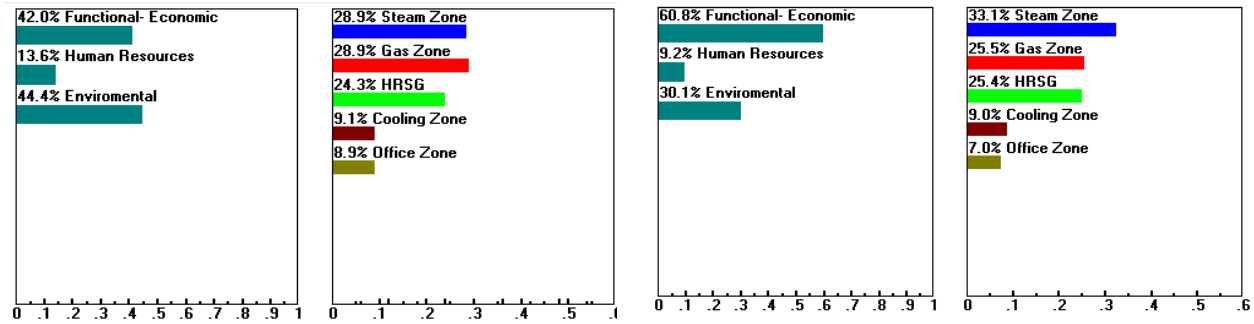
The theme of sustainable building is not deplete resources, disturb ecosystems, or disrupt natural life rhythms during design, construction, operation, maintenance and demolition of a building. Since it is inevitable to carry out human activities with some negative influence on the environment and building itself, the adoption of sustainable buildings tends to cut down as many negative effects as possible. Design is a central element of sustainable building practice [19].

In this article, the importance of prioritization in various fields in combined cycle power plants, according to the criteria of sustainable development, performance – economic criteria was ranked in the first priority which has been given according to the experts (0.541). According to the effect of these criteria on alternatives, the alternative of combined cycle power plants steam zone in first priority with the final weight was 0.313. As well as in the sensitivity test, it also was true.

Table 4 The final weighting criteria of sustainable development and selection of suitable space

	Steam Zone	Gas Zone	Administrative	HRSG Zone	Cooling Zone	Office Zone
Functional- economic (L: .541)	0/227	0/1	0/017	0/15	0/047	0/541
Human resources (L: .108)	0/023	0/016	0/057	0/004	0/009	0/109
Environmental (L: .352)	0/063	0/15	0/012	0/092	0/034	0/351
Grand Total	0/313	0/266	0/086	0/246	0/09	1/001

Determining period sensitivity test is as follows:



Functional- economic	42%	60.8%
Human resources	13.6%	9.2%
Environmental	44.4%	30.1%

Fig. 10 Determining period sensitivity test

As discussed above, the sensitivity test in Economic Function in weight 42% steam zone and gas zones alternatives were almost equally. By increasing this number up to 60.8%, HRSG and gas zone had the same weight. In this period, No changes occurred in the priority alternatives and by more numbers and less than this amount, alternatives should be changed Fig. 9.

The findings showed that even though the environmental factor is in the top point of the researches of the world, it is in the second priority in constructing combined cycle power plants Table 4. *Thus the supposition of the paper is rejected.*

Power plants with various methods of producing electricity have a collection of areas. This issue in combined cycle power plants is different from one zone to other zone. For this purpose, in this study, if spaces were related to the zone of steam in the first place, in summing up these factors in planning and its design, there should be priorities stronger than other zones. According to the studies and analyses carried out in this regard, following results can be deduced Table 6.

Table 6 The effectiveness of the principles of sustainable development on space priority in combined cycle power plants

Principles of sustainable development	Way of impressionable	Stages of effectiveness	Positive effect in construction
Functional-economic	Provide adequate performance for security and safety with optimal economy Provide adequate performance for in direction observance regulations and standards with optimum economy Provide adequate performance for strength with optimal economy Reducing the costs associated with changes after operation Economic efficiency in terms of choosing the best equipment technology Economic efficiency by estimating the time and cost Choose the best construction technology in terms of economic efficiency	Before construction Design During construction After construction	**Reduce or control**
Human resources	Suitable performance for human activity and need to space change to meet this requirement Using symptoms of social and historical meaning in building		**Improvement**
Environmental	Choose the best technology of equipment to reduce of industrial pollutants Choose the best technology of equipment in order to increase the efficiency and power generation Choose the best technology of equipment in order to conserve natural resources: recycled materials, energy analysis and.		**Reducing negative risk**

5. CONCLUSION

As it is clear from the above table, observing the principles of sustainable development is in the direction of controlling and reducing the economic, social and environmental risks and continues from pre-construction stages up to operation. In fact, sustainable architecture targets lifecycle of a building and in all stages, it has an effect.

In order to be in line with the objectives of sustainable development that is an updated and global issue and as productivity has an increasing significance economically in designing combined cycle power plants, when producing power with an economic fixed price is desired, subjects as new equipment and optimal technology of production are discussed. In fact, these issues have been presented and innovated by presupposition of the best productivities. Some ways for reducing the costs of decreasing environmental pollution among the commitments of a power plant are part of the privileges of using these technologies. These technologies are valued and evaluated by putting them together and meeting the maximum demands.

NOTES

1. Lowest life-cycle cost
2. WCED
3. MCDA is a term that includes a set of concepts, methods and techniques that seek to help individuals or groups to make decisions, which involve several points of view in conflict and multiple stakeholders.
4. AHP
5. MCDM

CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest regarding the publication of this manuscript.

REFERENCES

[1] Hoang T, Pawluskiewicz DK. The efficiency analysis of different combined cycle power plants based on the impact of selected parameters, International Journal of Smart Grid and Clean Energy, 2016, Vol. 5, No. 2, pp. 77–85.

[2] Siemens. Siemens Combined Cycle Power Plants from Plans to Plants/ www. Siemens.com/ energy, 2012.

[3] Heidari A, Mohammad Hoseini P, Feridony. H. Architectural impact of smart growth and sustainable development in Sadra new town in Shiraz with ecological approach, International Research Journal of Applied and Basic Sciences, 2013, Vol. 4, No. 12, pp. 3611-3617.

[4] Zhai ZJ, McNeill JS. Roles of building simulation tools in sustainable building design, Building Simulation, 2014, Vol. 7, No. 2, pp. 107–109.

[5] IFC. Environmental, Health, and Safety Guidelines for Thermal Power Plant/www.ifc.org/ifcext/sustainability.nsf/Content/EnvironmentalGuidelines, 2008.

[6] Sarucan. A, Emin Baysal M, Kahraman C, Engin O. A hierarchy grey relational analysis for selecting the renewable electricity generation technologies, Proceedings of the World Congress on Engineering, 2011, Vol. 2, July 6-8, London, U.K.

[7] Eskom Holdings. Environmental Impact Assessment Process: Final Scoping Report for the Richards Bay Combined Cycle Power Plant (CCPP) and Associated Infrastructure near Richards Bay/www.eskom.co.za/.../EnvironmentalImpactAssessments/RichardsBayCCPP, 2017.

[8] Iberdrola. Arcos Combined Cycle Plant Environmental Statement 2016/https://www.iberdrola.com/wcorp/gc/prod/en_US/.../docs/DA_CC_Arcos.pdf, 2017.

[9] Butera FM. Climatic change and the built environment, Advances in Building Energy Research, 2010, Vol. 4, No. 1, pp. 45–75.

[10] Seunghwa P, Kim I. Bim - based quality control for safety issues in the design and construction phases, International Journal of Architectural Research, 2015, Vol. 9, No. 3, pp. 111-129.

[11] Lim YW. Building information modeling for indoor environmental performance analysis, American Journal of Environmental Sciences, Vol. 11, No. 2, pp. 55-61.

[12] Rathod R. Gidwani GD, Solanky P. Hazard analysis and risk assessment in thermal power plant, IJESRT, 2017, Vol. 6, No. 7, pp. 177–185.

[13] Iran menanco Consulting Company. Introduction with the principles of Designing Thermal Power plants , Vol. 2, Shiveh Publication, Tehran, 2011.

[14] Ishizak A. Labib A. Analytic hierarchy process and expert choice: benefits and limitations, Journal of ORInsight, 2009, Vol. 22, No. 4, pp. 201–220.

[15] Saaty TL. The analytic hierarchy process, New York: McGraw-Hill. 1980.

[16] Resobowo DS, Buda KA, Dinariyana AAB. Using sensitivity analysis for selecting of ship maintenance variables for improving reliability of military ship, Academic research international, 2014, Vol. 2, No. 5, pp. 127-139.

[17] Aragonés BP, Mendoza-Rocab JA, Bes-Piáa A, García-Melónb M, Parra-Ruizb E. Application of multi criteria decision analysis to jar-test results for chemicals selection in the physical–chemical treatment of textile wastewater, Journal of Hazardous Materials, 2009, Vol. 164, No. 1, pp. 288-295.

[18] Abdullah A, Anumba CJ, Durmisevic E. Decision tools for demolition techniques selection, 11th Rinker International conference on Deconstruction and Materials Reuse, Gainesville, Florida, USA, 7-10 May 2003, Chini AR, (Ed.), 2003, pp. 55-72.

[19] Liu S, Meng X, Tam C. Building information modeling based building design optimization for sustainability, Journal of Energy and Buildings, 2015, Vol. 105, No. 15, pp. 139–153.

AUTHOR (S) BIOSKETCHES

Hessari, P; *PhD Candidate, Architecture Imam Khomeini International University (IKIU), Imam Khomeini International University (IKIU), Qazvin, Iran*
Email*: Pedramhessari2012@yahoo.com*

Zandieh, M; *Associate Professor, Imam Khomeini International University (IKIU), Imam Khomeini International University (IKIU), Qazvin, Iran*
Email*: Mahdi_zandieh@yahoo.com*

Mahmuodzadeh Kani, I; *Professor, Tehran University School of Civil Engineering, University of Tehran, Tehran, Iran*
Email*: Inkani@ut.ac.ir*

HOW TO CITE THIS ARTICLE
Hessari, P; Zandieh, M; Mahmuodzadeh Kani, I; (2018). The Significance of the Priority of Applying the Parameters of Sustainable Development in Combined Cycle Power Plant Design. Int. J. Architect. Eng. Urban Plan, 28(1): 105-115, June 2018.

URL: http://ijaup.iust.ac.ir/article-1-384-en.html