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An evaluation of Bionical Creativity in New Technology of Sustainable Buildings Construction

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Abstract

Human have always modeled the nature to meet their needs in architectural scope. This modeling which is called "bionics creativity" is of high importance and can increase technologies advancement since bionics creativity application depends on interdisciplinary understanding and cooperation among specialists. Technological advancement in architecture leads to future sustainable architecture and plays a significant role in sustainable buildings construction. In this regards, the present study has attempted to investigate the role of bionical creativity in new technology of sustainable buildings construction. Due to the importance of the research results, innovative aspect of the subject as well as lack of enough public knowledge about the issue, the statistical population has been selected among architecture professors and consultant engineers; and the data gathered has been processed in SPSS software. Based on testing the research hypotheses which all have been confirmed, it can be concluded that all determined indices can be applied as a pattern to use bionical creativity in order to increase the sustainability of buildings.

Keywords: Bionics, sustainable architecture, new technologies, architecture, pattern.

Introduction

Since bionical creativity application depends on the amount of interdisciplinary understanding and cooperation among specialists, it can lead to increasingly advance of technologies. Such technology development in architecture leads to future sustainable architecture and plays a significant role in sustainable buildings construction[1]. Today, designers are testing and developing construction technologies based on solar cells, intelligent signs, live walls, thermal mass, and natural ventilation; and by this way, they seek to achieve sustainable architecture through new construction technologies[2].

One of the dimensions of sustainability is the interaction between human and environment. Considering the fact that nature and ecosystem of human provide all necessary things to live for them, it has been considered as the source of inspiration and demands supply for a long time[3]. One of the dominant and committed attitudes to such view in architectural scope is bionics architecture and the view inspired by the nature. Human who have always been dependent on nature to build weapon, house and all their life`s elements, have tried to discover proper patterns of housing from nature during a long process[4].

Chen based on his study on "bionics techniques application to design materials used in buildings facades, claimed that bionics is the architecture based on new technologies, new resources, ecological theory, and sustainable development theory[5]. They introduced concretes based on bionics technology used in different parts of building such as structure, frame, materials, or other parts of façade. He believed that bionics technology follows the objectives like energy saving and ecological balance[6].

In another study on "bionics techniques application in sustainable design and construction process" done by Naguib and Hanafi, an architectural approach inspired by nature was introduced[7]. The proposed approach was used to save energy in sustainable development. Naguib and Hanafi stated that buildings should convey new ecological concepts to society and reveal a better understanding from environment in architectural design. Therefore, construction is used not only to conserve environment but it generates positive environmental effects as well[8].

Zhang et al. based on their study on "bionics and building structures", introduced two different methods to investigate biometric structures: one method was based on the various materials used by imitating the nature and another method was based on the objectives followed in biometric designs by imitating the nature[9]. Finally, the concept formed from bionics was analyzed under a tree structure.

In the study done by Shojaei and Nejati on "bionics science; the base of contemporary architecture", it was stated that what is currently known as bionic architecture is the result of the efforts of architectures trying to remove defects and human errors in construction with a new attitude to complete architecture and structure in natural frames[10].

Taher Moghadas and Kimia conducted a study on "bionics engineering and sustainable architecture"[11]. They asserted that the high importance of bionics is due to its interdisciplinary feature and creativity bionics engineering is presented as a new

engineering strategy of problem solving and its strategies are used continuously. They also stated that creativity bionics engineering is applied in various scopes and models natural structures and principles for creative problem solving in various scientific scopes.

Considering the fact that valuation of bionical creativity in new technology of sustainable buildings construction is the purpose of the present study, the following hypotheses are tested to find the answers of the study questions

The alterative hypothesis: "Bionical creativity application affects new construction technologies application in sustainable buildings".

The secondary hypotheses: i. "Bionical creativity application leads to the optimal use of materials in sustainable buildings". ii. "Bionical creativity application leads to the maximum structural power in sustainable buildings". iii. "Bionical creativity application leads to the creation of efficient environments in terms of energy, well-insulated, and convenient without the need to use external energy in sustainable buildings". iv. "Bionical creativity application leads to the creation of forms based on rapid circulation improvement in sustainable buildings".

Methodology

The present research is a content analytical study and the data gathering tool is in the form of qualitative analysis of concepts and the theories available regarding new construction technologies application in sustainable buildings in investigated constructions. To investigate the indices quantitatively, a questionnaire has also been used. In this study, a combination of correlation method and qualitative method has been used in order to evaluate several variables and their relations in real conditions. In correlation method as a quantitative method, the relation between each independent variable and the dependent variable (the role of bionical creativity) has been signified. Due to the importance of the research results, innovative aspect of the subject as well as lack of enough public knowledge about the issue, the statistical population has been selected among architecture professors and consultant engineers (group 1) and BA and MA students of architecture (group 2). Using purposeful sampling, the statistical sample has been selected including 50 architecture professors, 30 consultant engineers with the age range of 30 to 50 years old, and 20 BA and MA students of architecture ranging from 21 to 30 years old. Finally, the quantitative data gathered has been processed in SPSS software.

Normality and fitness test: To evaluate the normal distribution of variables (Bionical creativity application and new construction technologies in sustainable buildings and its component of optimal material use, structural power maximization, proper energy absorption, and rapid circulation improvement), S-K test has been used. In single sample case, S-K test compares observed accumulative distribution function with expected accumulative distribution function in a variable at ordinal scale measurement. In other words, distribution of an attribute in a sample can be compared with the given distribution of the population. In results` interpretation, observed distribution and theoretical distribution will be same and there will be no difference between them if the value of observed error level is greater than 0/05; that is, obtained distribution is a normal distribution. While there will be a difference between observed distribution and expected distribution if the significance value is less than 0/05; i.e. the distribution is not normal.

As shown in table 1, the absolute, positive and negative differences for variable have been estimated. The absolute difference indicates the greatest difference between observed accumulated distribution and expected accumulated distribution; the positive difference indicates the value of the point in which observed accumulated distribution function is greater than expected accumulated distribution function while the negative difference shows the value of the point in which observed accumulated distribution function is less than expected accumulated distribution function. According to table 1, with respect to the obtained value of K-S test and the observed error level, it can be concluded that there is no significance difference between expected distribution and observed distribution for variables of bionical creativity application and new construction technologies in sustainable buildings and its component of optimal material use; thus, the distribution of variables is normal but the theoretical distribution of other variables is not normal and the difference is significant.

Table-1
Normality and Fitness Test

	Absolute Difference	**Positive Difference**	**Negative Difference**	**K-S**	**P-Value**
Bionical Creativity	0/133	0/133	-0/102	0/866	0/588
New Construction Technology	0/129	0/129	-0/086	0/806	0/549
Material Optimization	0/125	0/125	-0/082	0/724	0/611
Structural Power Maximization	0/240	0/240	-0/223	1/631	0/010
Energy Absorption	0/225	0/225	-0/182	1/523	0/019
Rapid Circulation Improvement	0/267	0/267	-0/189	1/812	0/003

Results and Discussion

Testing the alternative hypothesis: The alternative (main) hypothesis: "Bionical creativity application affects new construction technologies application in sustainable buildings".

H_0: Bionical creativity application does not affect new construction technologies application in sustainable buildings.
H_1: Bionical creativity application affects new construction technologies application in sustainable buildings.

In this hypothesis, Pearson correlation coefficient is used to investigate the relation between bionical creativity application and the new construction technologies in sustainable buildings. Then, the results are interpreted.

Table-2
Pearson Coefficient Statistic

Row	Variable	Pearson coefficient value	P-Value	Total
1	Bionical creativity application and construction technology	0/889	0/000	50

According to table-2, considering the value of Pearson statistic (0/89) and the observed error level (P-Value < 0/05), it can be concluded that the relation between variables is significant at the confidence level of 0/99. In other words, the alternative hypothesis is confirmed indicating that there is a significant relation between bionical creativity application and the new construction technologies in sustainable buildings.

Also, the obtained correlation coefficient indicates that the relation is strong, positive and direct. In other words, bionical creativity application affects new construction techniques in sustainable buildings up to 89%. Figure 1 depicts new construction techniques in sustainable buildings based on bionical creativity application.

Testing Secondary Hypotheses: The first hypothesis: "Bionical creativity application leads to the optimal use of materials in sustainable buildings".

H_0: Bionical creativity application does not lead to the optimal use of materials in sustainable buildings.
H_1: Bionical creativity application leads to the optimal use of materials in sustainable buildings.

In this hypothesis, to estimate the significance level of the relation between bionical creativity application and the optimal use of materials in sustainable buildings, Pearson correlation coefficient is used. The results are interpreted.

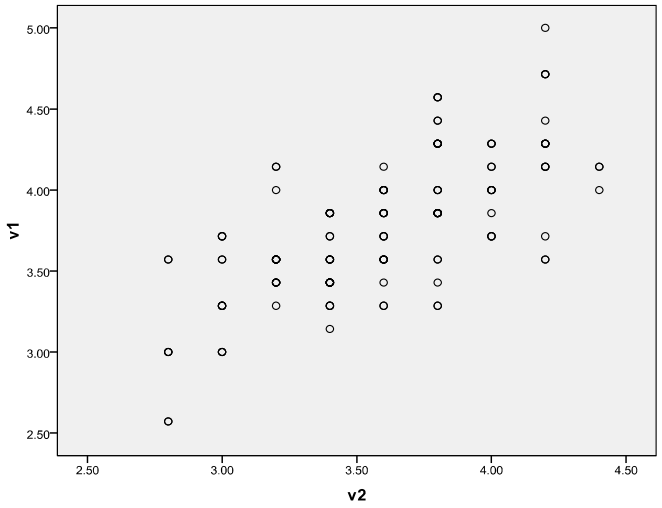

Figure-1
TheDiagram of New Construction Techniques in Sustainable Buildings based on Bionical Creativity Application

Table-3
Pearson Coefficient Statistic

Row	Variable	Pearson coefficient value	P-Value	Total
1	Bionical creativity application and the optimal use of materials	0/766	0/000	50

According to table 3, considering the value of Pearson statistic (0/76) and the observed error level (P-Value < 0/05), it can be concluded that the relation between variables is significant at the confidence level of 0/99. In other words, the alternative hypothesis is confirmed indicating that there is a significant relation between bionical creativity application and the optimal use of materials in sustainable buildings.

Also, the obtained correlation coefficient indicates that the relation is strong, positive and direct. In other words, bionical creativity application affects optimal use of materials in sustainable buildings up to 76%. Figure 2 depicts the optimal use of materials in sustainable buildings based on bionical creativity application.

The second hypothesis: "Bionical creativity application leads to the maximum structural power in sustainable buildings".

H_0 : Bionical creativity application does not lead to the maximum structural power in sustainable buildings.
H_1 : Bionical creativity application leads to the maximum structural power in sustainable buildings.

In this hypothesis, Spearman correlation coefficient is used to investigate the relation between bionical creativity application and the structural power maximization. Then, the results are interpreted.

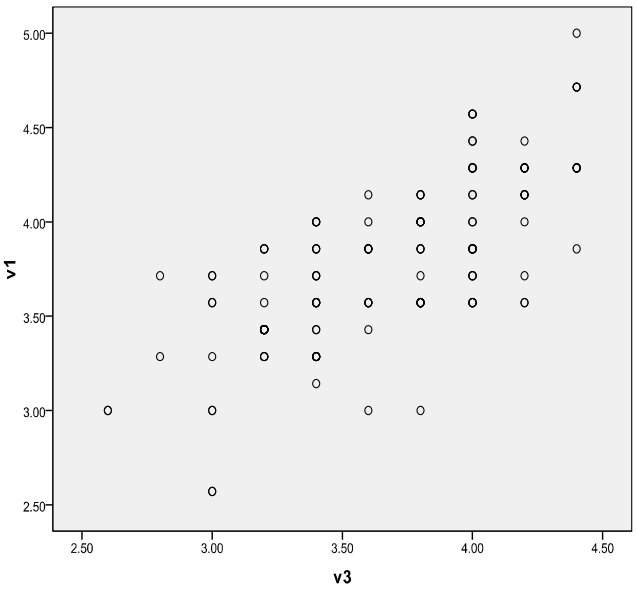

Figure-2
The Diagram of the Optimal Use of Materials in Sustainable Buildings based on Bionical Creativity Application

Table-4
Spearman Coefficient Statistic

Row	Variable	Spearman coefficient value	P-Value	Total
1	Bionical creativity application and the structural power maximization	0/825	0/000	50

According to table 4, considering the value of Spearman statistic (0/85) and the observed error level (P-Value < 0/05), it can be concluded that the relation between variables is significant at the confidence level of 0/99. In other words, the alternative hypothesis is confirmed indicating that there is a significant relation between bionical creativity application and the structural power maximization.

Also, the obtained correlation coefficient indicates that the relation is strong, positive and direct. In other words, bionical creativity application affects the structural power maximization up to 82%. Figure 3 depicts the structural power maximization based on bionical creativity application.

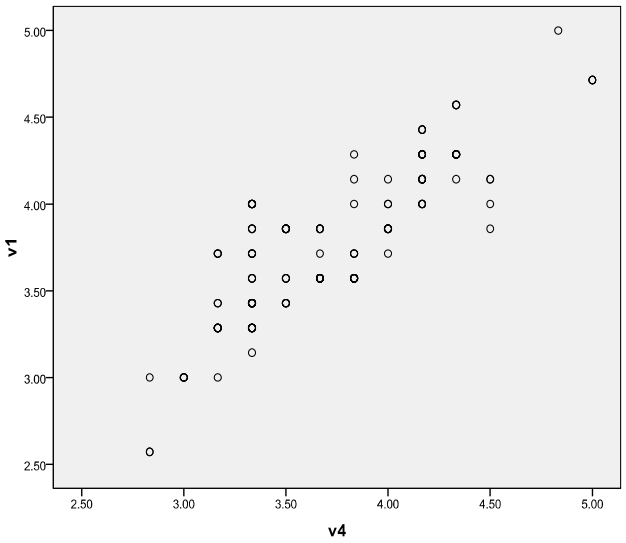

Figure-3
The Diagram of Structural Power Maximization based on Bionical Creativity Application

The third hypothesis: "Bionical creativity application leads to the creation of efficient environments in terms of energy, well-insulated, and convenient without the need to use external energy in sustainable buildings".

H_0: Bionical creativity application does not lead to the creation of efficient environments in terms of energy in sustainable buildings.
H_1: Bionical creativity application leads to the creation of efficient environments in terms of energy in sustainable buildings.

In this hypothesis, Spearman correlation coefficient is used to investigate the relation between bionical creativity application and the creation of efficient environments in terms of energy in sustainable buildings. Then, the results are interpreted.

Table-5
Spearman Coefficient Statistic

Row	Variable	Spearman coefficient value	P-Value	Total
1	Bionical creativity application and the creation of efficient environments in terms of energy	0/777	0/000	50

According to table-5, considering the value of Spearman statistic (0/77) and the observed error level (P-Value < 0/05), it can be concluded that the relation between variables is

significant at the confidence level of 0/99. In other words, the alternative hypothesis is confirmed indicating that there is a significant relation between bionical creativity application and the creation of efficient environments in terms of energy in sustainable buildings.

Also, the obtained correlation coefficient indicates that the relation is strong, positive and direct. In other words, bionical creativity application affects structural power maximization up to 77%.

Figure-4 depicts the creation of efficient environments in terms of energy in sustainable buildings based on bionical creativity application.

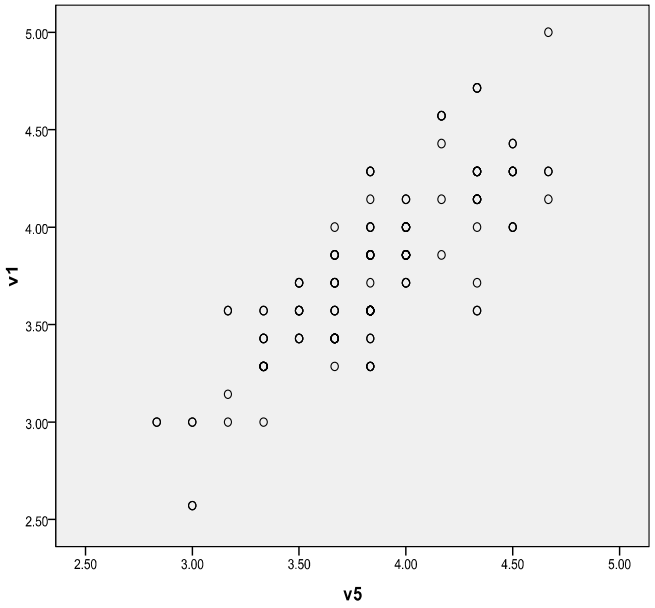

Figure-4
The Creation of Efficient Environments in Terms of Energy in Sustainable Buildings based on Bionical Creativity Application

The fourth hypothesis: "Bionical creativity application leads to the creation of forms based on rapid circulation improvement in sustainable buildings".

H_0 : Bionical creativity application does not lead to the creation of forms based on rapid circulation improvement in sustainable buildings.
H_1 : Bionical creativity application leads to the creation of forms based on rapid circulation improvement in sustainable buildings.

In this hypothesis, Spearman correlation coefficient is used to investigate the relation between bionical creativity application and rapid circulation improvement in sustainable buildings. Then, the results are interpreted.

Table-6
Spearman Coefficient Statistic

Row	Variable	Spearman coefficient value	P-Value	Total
1	Bionical creativity application and rapid circulation improvement in sustainable buildings	0/891	0/000	50

According to table-6, considering the value of Spearman statistic (0/89) and the observed error level (P-Value < 0/05), it can be concluded that the relation between variables is significant at the confidence level of 0/99. In other words, the alternative hypothesis is confirmed indicating that there is a significant relation between bionical creativity application and the creation of efficient environments in terms of energy in sustainable buildings.

Also, the obtained correlation coefficient indicates that the relation is strong, positive and direct. In other words, bionical creativity application affects rapid circulation improvement in sustainable buildings up to 77%. Figure 5 depicts the rapid circulation improvement in sustainable buildings based on bionical creativity application.

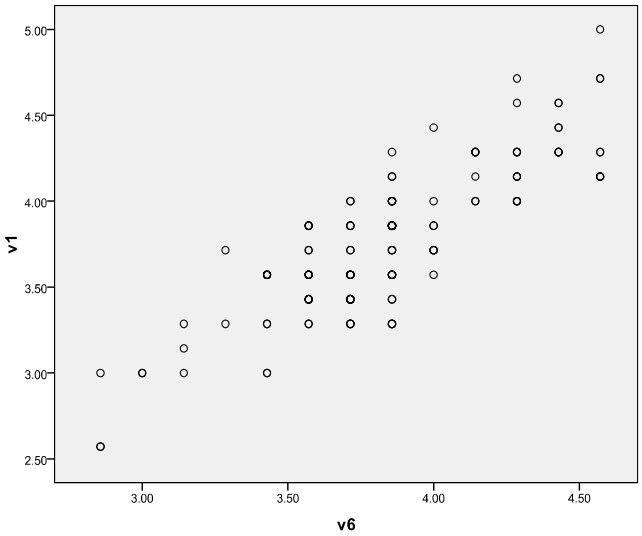

Figure-5
The Rapid Circulation Improvement in Sustainable Buildings based on Bionical Creativity Application

Conclusion

With respect to the proposed discussions and considering the buildings constructed by natural forms inspirations, it can be concluded that bionical creativity application has been widely

increased in architectural works[12]. On the other hand, designers and architectures should take this fact into consideration that detailed imitation of the nature and environment is not a simple work to do for every project and all aspects including geographical, climatic, economic issues should be considered.

By attempting to understand the principles governing on the nature, observing, feeling or smelling the natural forms, the natural functional performance may be achieved (e.g. beauty is achieved through maximum efficiency of materials and form). To develop architectural forms found in the nature, there are basic principles which can be used in most of new buildings. It is resulted in a tremendous design combining structural efficiency, functional and aesthetic needs. In bionical creativity application, it should also be considered that the lessons learnt from the nature should be used properly and mere imitation cannot be useful.

The present study intended to investigate the role of bionical creativity in new technology of sustainable buildings construction. In this regards, some indices of new technology in sustainable architecture associated with bionical creativity application were evaluated. In all the hypotheses, bionical creativity was treated as an opportunity which can be used to achieve sustainable architecture. The results of testing hypotheses revealed that all the determined indices can be applied as a pattern for bionical creativity application in order to increase the sustainability of constructions.

Based on the obtained results, bionical creativity application affects new construction techniques in sustainable buildings, the structural power maximization, the creation of proper environment in terms of energy in sustainable buildings, and the creation of forms based on rapid circulation improvement up to 89%, 76%, 82%, 77%, and 89%, respectively. All these findings prove the high effectiveness of bionical creativity application in sustainable buildings in line with new construction technology.

Reference

1. Xiang Ke and Chaogzhao Su, Bionic design of building structure based on digital technology -The design of the structural morphology of Muping Sports Center" Electronic and Mechanical Engineering and Information Technology (EMEIT), *2011 International Conference on. 9*. IEEE, **(2011)**

2. Rahimi E. and Hoseini R., Bionics and art frames in the nature, *architectural art magazine*, 11**(2008)**

3. Glenn Zorpette and Carol Ezzell, YourBionic future, *Scientific American Presents, Feature Article* **(1999)**

4. Hagan S., Taking Shape: A New Contract between Architecture and Nature, *Architectural Press*, St. Louis, USA, **(2001)**

5. Chen, Ling Ling, The Application of Bionics Techniques in the Designing of Building Material Skin", *Applied Mechanics and Materials*, 174, **(2012)**

6. Ruskin J., The Seven Lamps of Architecture", George Allan, London, **(1906)**

7. Naguib M.M. and M.A.M. Hanafi, Exploring the Applications of Bio-Eco Architecture for Sustainable Design and Construction process, *European Journal of Sustainable Development,* **2(4)**, 85-96 **(2013)**

8. Dev Nikhil, Attri Rajesh, Mittal Vijay, Kumar Sandeep, Mohit Satyapal and Kumar Pardeep, Economic_and Performance_Analysis_of_Thermal_System, *Res. J. Recent Sci.,* **1(4),** 57-59 **(2012)**

9. Zhang Qian, ZhiHua Chen and Xiao Dun Wang, Bionics and Building Structure, *Applied Mechanics and Materials,* **94**, 450-455**(2011)**

10. Shojaei A., The science of bionics; the base of contemporary architecture, The first national conference of the fourth conference of higher education institute of Khavaran, *new technologies in engineering sciences, Mashhad,* **(2010)**

11. Taher Moghadas P. and Kimia F., Bionical creativity engineering and sustainable architecture, the third national conference of creatology, *TRIZ and innovation engineering of Iran,* **(2010)**

12. Armin Sadeghi Adl, Keramatollah Ziari and Kiomars Habibi, Planning_of_Land-use_Along_with_Environmental Sustainability:_A_Case_Study_of_the_District_22_Tehran, Iran, *Res. J. Recent Sci.,***3(2),**16-25 **(2014)**

13. Selvam S., Manimaran G., Sivasubramanian P. and Seshunarayana T., Geoenvironmental Resource Assessment Using Remote Sensing and GIS: A Case study from Southern Coastal Region, *Res. J. Recent Sci*., **3(1)**,108-115**(2014)**

14. Riaz Ahmed, Noor Azmi and Muhammad TahirMasood, The Essence of Project Leadership is Significant to Project Management, *Res. J. Recent Sci*., **2(5)**,44-48**(2013)**

15. Shokrollah Pouralkhas, Death Rock in Masnavi Benchmark, *Res. J. Recent Sci*., **2(5)**, 63-67 **(2013)**