

The Relation between Motif and Form in Middle Bakun Ceramics of Toll-e Rahmatabad in Fars Region (Fifth Millennium BC), using Statistical Linear Models

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Abstract: The prehistoric Bakun culture of Fars during the Chalcolithic period (i.e. the fifth millennium BCE), is unparalleled among the contemporaneous cultures of Iran with regard to the diversity of its pottery techniques and creating specific geometric, animal, and human motifs. In this period, very diverse forms of pottery were produced by full-time expert potters. Toll-e Rahmatabad, located in the Kamin Plain of Pasargadae district, is one of the prehistoric regions which acted as a pottery production center during the fifth millennium BC in the Middle Bakun Period. In archaeological excavations carried out in this site during three seasons, direct archeological evidence of production and thousands of pieces of pottery belonging to the mentioned cultural period were discovered. In the present study, the relationship between the form and design in these ceramics was examined by using statistical linear models and SPSS Software. The significance level in all the tests was set at 0.05. The results of data analyses indicated a significant relationship between the form and design of pottery during the Middle Bakun Period at Toll-e Rahmatabad.

Keywords: Bakun; Toll-e Rahmatabad, Statistical Linear Models, Form, Design.

Introduction

In the south of Iran, Fars Province, to the north of Shiraz, and at the western end of Sa'adat Abad Plain after Ghasar Al-Dasht, there is a small village named Rahmatabad (Fig. 1). In the vicinity of this village and on the western side of Polvar River, there is a fairly high mound known as Toll-e Rahmatabad. This small oval-shaped site encompasses half a hectare and rises five meters above the level of the surrounding plain. The site is situated at 1774 meters above sea level and is located in front of the southern part of the Tangeh Bolaghi, just beside the Isfahan-Shiraz highway; its geographical coordinates are N. 30° 0.6' 42.41" - E. 53° 0.3' 26.94". The major parts of this site have been demolished and destroyed in recent years due to developmental and road-construction activities and only its central part remains. The southern part of the site has been

destroyed by the highway and its western part has been destroyed by the access road to Sivand Dam. The northern and eastern parts have been demolished by development of rural homes. The main core of the mound is fenced by Cultural Heritage, Handicrafts and Tourism Organization

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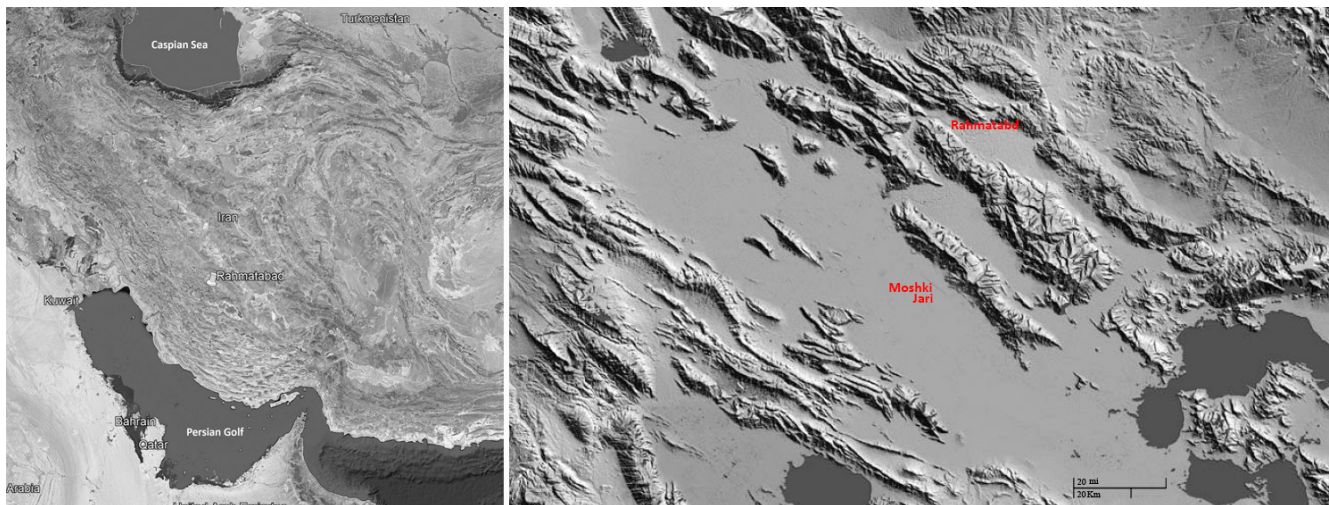


Fig. 1. Geographical location of Rahmatabad in Iran (left) and in relation to Marvdasht (right).

of Fars Province. The exact area of the fenced region which is known as Toll-e Rahmatabad is 4707 square meters and it is registered in 19/7/1976 with the number of 1262 in the list of Iranian National Monuments (Figs. 2 and 3).

As recovered from the archeological excavations and confirmed by radiocarbon dating, the nine meters of cultural layers at the site encompass components from the Late Islamic Period (remains of a cemetery belonging to the Qajar period), artifacts from adobe structures of the Achaemenid Period, as well as artifacts from Bakun and Neolithic Periods (Azizi Kharanaghi 2009; Azizi Kharanaghi *et al.* 2012: 78-105). The second season of archeological excavations of Toll-e Rahmatabad began in 2009 with the purpose of clarifying the stratigraphy of the site to anchor the relative and absolute chronology of the region, which was not available in the first season. During that season, 5×10 meter stepped trenches (Trench G) were excavated with the purpose of conducting stratigraphic examinations in the center and top of the mound and very outstanding artifacts from the Neolithic Period were discovered in the lower layers; besides, cultural layers of Neolithic phase were discovered for the first time which were introduced as Rahmatabad phase. The radiocarbon samples from these contexts resulted in extending this history back to the Mushaki Phase, which has been regarded as the oldest Pottery Neolithic phase in Fars (Azizi Kharanaghi *et al.* 2012: 96). Considering the amount of material excavated in 2009, especially in the layers belonging to Neolithic Period, and also in view of the severe shortage of cultural material due to the small dimensions of the excavation, it was decided for the next season to excavate in prehistoric layers by producing larger trenches.

The third season of archeological excavations of Rahmatabad took 40 days and was conducted in January and February 2011 with the purpose of excavating the Neolithic layers of the site as well as understanding the

Pre-Pottery Neolithic Period. The transition from the Pre-Pottery to Pottery Neolithic phase was a particular focus of this season given confusion over its absolute and relative chronological position. In this season, a 5×5 trench immediately adjacent to the eastern part of Trench G was excavated by foreseeing a one-meter-wide arm named Trench H. Overall thickness of the trench's cultural layers is 6.5 meters and its identified cultural layers include Bakun and Neolithic Periods which are fully described in the following sections. A small 1×2 borehole named "Test Borehole I" was excavated on the west of the mound (Fig. 3), exactly beside the asphalt access road to Sivand Dam. This borehole was an accumulation of ash and probably a landfill whose absolute time dates back to Mushaki Formation Phase (the early Pottery Neolithic Phase) (Table 2) (Azizi Kharanaghi 2009).

Review of the related literature and purpose of the study

The first season of archeological excavations of Rahmatabad began simultaneously with the project of rescue excavations of Sivand Dam in 2005. This region is located beside the Isfahan – Shiraz highway and on the south of the Tangeh Bolaghi and north of Kamin Plain (Sa'adat Shahr Plain); it has been transgressed due to the highway widening. In June 2005, the excavation of Toll-e Rahmatabad in Fars resulted in the discovery of unique artifacts of earthenware furnaces and very diverse types of pottery with different designs and forms belonging to fifth millennium BC (Azizi Kharanaghi 2007; Fazeli Nashli *et al.* 2008: 101-124, 2008: 59-68; Bernbeck *et al.* 2005; Marghussian *et al.* 2009).

The mentioned excavations were conducted under the supervision of Hassan Fazeli Nashli from Tehran University, with Susan Pollock and Reinhard Bernbeck from State University of New York. In the first season's excavations



Fig. 2. Aerial photos of Rahmatabad, before archeological excavations (Parseh-Pasargadae Research Foundation Archive, photographer: Mohammad Taghi Ataee).

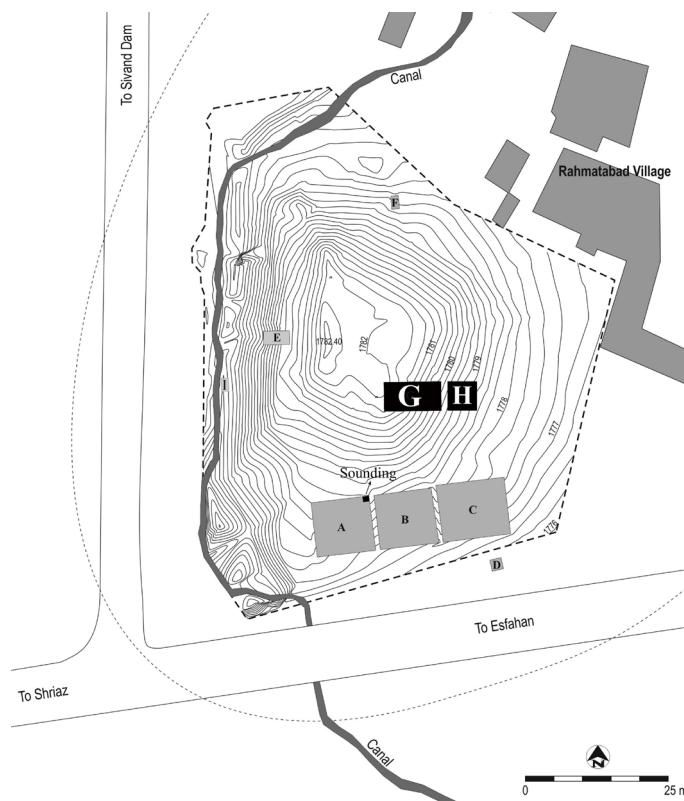


Fig. 3. Topography of Toll-e Rahmatabad (black squares TR H and I are the excavated trenches in the third season).

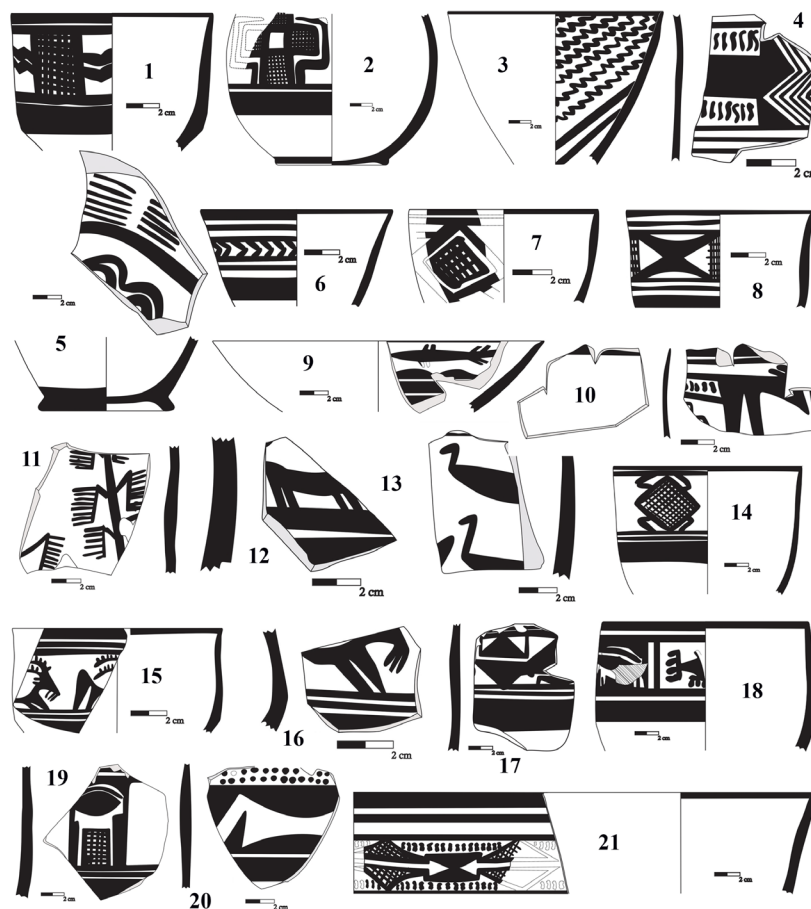


Fig. 4. Middle Bakun Period potteries from Toll-e Rahmatabad

of this region, three large 10×10 trenches (Trenches A, B, and C) were excavated in parallel to each other on the southern slope of the mound, a stratigraphic trench (D) was excavated in the southern border of the mound along the main Isfahan-Shiraz road; another stratigraphic trench on the western side of the region named E was also excavated; moreover, the other stratigraphic trench (Trench F) was excavated in the northern part of the site along the edge of Rahmatabad Village. In these excavations, parts of industrial architecture of Bakun belonging to the fifth millennium BC were identified. Large scale excavations were not resumed until 2009.

The second season of excavation at Toll-e Rahmatabad was conducted with the purposes of continuing the excavations of first season in Trench C, to further uncover the industrial architecture of the Bakun Period in the fifth millennium BC, producing new stratigraphy trench (Trench G), and presenting relative and absolute chronology from Rahmatabad (Azizi Kharanaghi *et al.* 2012:86).

Unfortunately, all the architectural evidences of Trench C identified in season one have been destroyed due to lack of protection and the trench has become a place for accumulation of villagers' waste. Some parts of

the fences surrounding the region have been broken and taken away which has contributed to the destruction of the site. After collecting the garbage and beginning the excavations in this trench, valuable architectural evidence of earthenware furnaces dating to the Bakun Period (the fifth millennium BC) were uncovered, which afforded a new understanding of the pottery production process in the aforementioned cultural period, which was previously unknown. Considering the excavations in Trench C, there is only one architectural phase in this trench and cultural layers belonging to Neolithic Period can be observed under the industrial architectural artifacts of Bakun Period (Azizi Kharanaghi 2009).

Likewise, in this season, the stratigraphy Trench G was excavated as a step-trench. This trench with the dimensions of 10×5, was placed running east-west on the center and on the top of the mound, in order to expose the maximum sequence of cultural layers. Excavation of this trench resulted in very precise recognition of the cultural layers and periods of Rahmatabad Mound and almost nine meters of cultural layers were identified from the top of the mound to the virgin soil. The results of top-down stratigraphy are presented briefly:



Fig. 5. Samples of Middle Bakun Period ceramics from Toll-e Rahmatabad

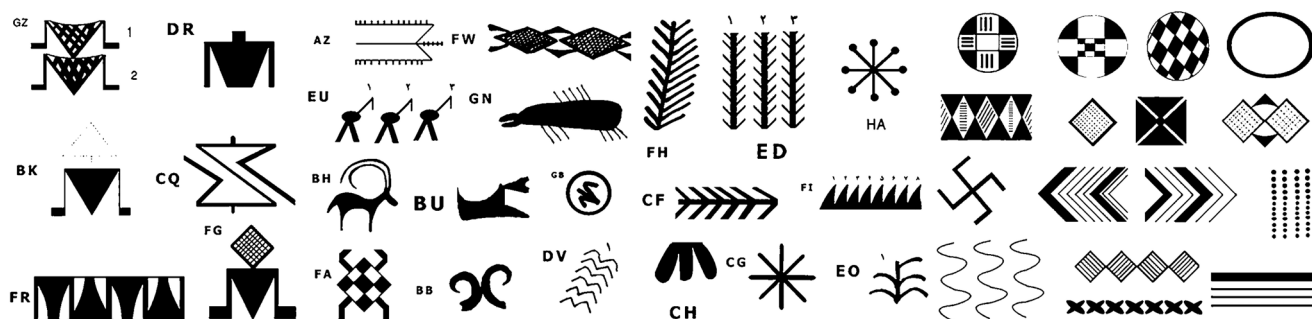


Fig. 6. All types of human, animal, geometric, and plant designs on the middle Bakun Period potteries of Rahmatabad (Fazeli and Azizi Kharanaghi 1999: Figs. 6 and 7).

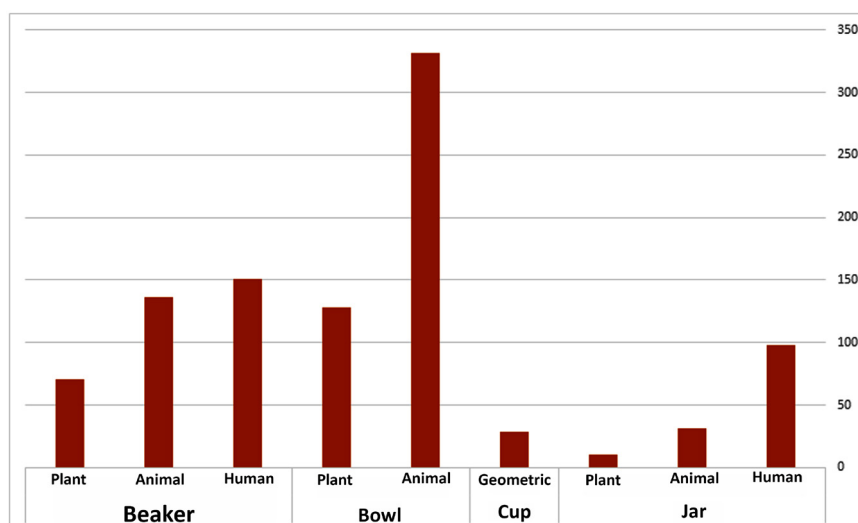


Diagram 1. Typology of different pottery forms and the designs used in each form

Late Islamic Period, Qajar (Islamic Cemetery)

The Achaemenid Period (adobe structures)

Bakun Period (the fifth millennium BC)

Pottery Neolithic Phase (includes two phases of Mushki Formation, the early seventh millennium BC and Mushki Phase, the late seventh millennium BC)

Pre-Pottery Neolithic Phase (Rahmatabad Phase, middle eighth millennium BC) (Azizi Kharanaghi *et al.* 2012: 79).

The main achievement of the second season of archeological excavations of Toll-e Rahmatabad was the identification of the cultural layers of Neolithic Period and the transition from the Pre-Pottery Neolithic to the Pottery Neolithic. Unfortunately, during the third season, excavations in the Neolithic layers were constricted only to a small leading borehole and the archeological evidences, especially coal samples from lower layers belonging to Pre-Pottery Neolithic Period, and the stages of transmission from Pre-Pottery Neolithic Period to Pottery Neolithic Period were not attained. Nevertheless, given that the archeological findings and the ceramics of this region have yet to be analyzed in depth, the present study tries to investigate the relationship between form and design in the ceramics of this period using statistical methods.

Materials and methods

The investigated pottery samples in this study were all obtained from the first season of archeological excavations

of Toll-e Rahmatabad. Among them, 989 pottery types whose forms and designs were recognizable were selected and all their extractable data were registered in an Excel spreadsheet. Overall, four categories of distinct and clear forms were identified which included 140 jars (14.1%), 30 cups (3%), 460 bowls (46.5%), and 359 tall glasses (36.3%). To analyze the data obtained from these pottery samples, the linear models including one-way analysis of variance and nonparametric Chi-Square Test were used and the significance level was set at $p=.05$. SPSS Software Version 18 was utilized to analyze the data.

Results

Table 1 includes the distribution of different geometric, plant, animal, and human designs on different pottery samples.

To investigate the relationship between form and design motifs of the pottery samples, a Chi-Square Test was utilized and the results indicated that there is a significant relationship between form and design of the potteries ($P<0.001$). Considering the observed values in each cell and the remaining values, it can be concluded that the cups alone have geometric designs, jars mostly have human designs, bowls mainly have animal designs and the tall glasses generally have human and animal designs.

Table 2 indicates the descriptive statistical indexes of the mean diameter of rim and bottom in different designs.

Table 1. the distribution of different designs in different forms of pottery samples from Middle Bakun Period

Design	Jar		Cup		Bowl		Beaker		Overall	
	Number	(%)	Number	(%)	Number	(%)	Number	(%)	Number	(%)
geometrical	98	70.5	0	0	0	0	151	42.2	249	25.3
Plant	31	22.5	0	0	331	72.1	136	38.0	498	50.6
Animal	10	7.2	0	0	128	27.9	71	19.8	209	21.2
Human	0	0	29	100	0	0	0	0	29	2.9
Overall	139	100	29	100	459	100	358	100	985	100

Table 2. Standard Deviation and Average of rim and bottom diameters of potteries with different designs

Variable	Design	Number	Average	Standard Deviation
Rim diameter (cm)	Human	197	16.59	7.39
	Animal	397	18.78	6.61
	Plant	174	19.12	6.29
	Geometrical	18	8.78	1.89
	Total	786	18.08	6.89
Bottom diameter (cm)	Human	20	7.20	3.59
	Animal	58	7.43	2.89
	Plant	18	8.17	3.54
	Geometrical	5	4.60	2.61
	Total	101	7.38	3.26

Table 3. Standard Deviation and Average of potteries' rim and bottom diameters in different discovered pottery forms

Variable	Form	Number	Mean	Standard Deviation
Rim diameter (cm)	Jar	105	16.50	8.72
	Cup	18	8.78	1.89
	Bowl	372	20.23	6.52
	Beaker	291	16.47	5.65
	Total	786	18.08	6.89
Bottom diameter (cm)	Jar	5	9.20	0.44
	Cup	5	4.60	2.61
	Bowl	56	7.98	3.14
	Beaker	35	6.54	3.41
	Total	101	7.38	3.26

To compare the mean diameter of rim and bottom in potteries with different designs, analysis of variance was used. The results of analysis of variance indicated a significant relationship between design and potteries' rim diameter ($P < 0.001$). Duncan's Post Hoc analysis indicated that the rim diameter in potteries having geometric designs has been significantly smaller than other designs; however, no statistically significant relationship was observed between rim diameters in potteries with the other three different designs. Likewise, this test showed that there is no statistically significant relationship between design and bottom diameter of the potteries ($P = 0.191$).

Table 3 presents the descriptive statistical indexes of mean and standard deviation of the rim and bottom diameters in different forms of the discovered potteries.

To compare the mean of rim and bottom diameters in potteries with different forms, analysis of variance was used. The results of analysis of variance indicated a significant relationship between form and rim diameter of the potteries ($P < 0.001$). Post Hoc Tests indicated that rim diameter in cup-form potteries has been significantly smaller than two forms of bowl and vat; however, no statistically significant relationship was observed between rim diameters in potteries with forms of cup and tall glass. Moreover, the rim diameters tall glass-form potteries had no statistically significant relationship with two forms of bowl and vat.

The results of analysis of variance indicated that there is a statistically significant relationship between form and the diameter of ceramic bases ($P = 0.022$). Post Hoc Tests revealed that the mean of bottom diameter in potteries with vat or tall glass forms did not have significant relationship with each other but it was significantly smaller than bottom diameter of bowl-form potteries.

Discussion and conclusion

Although using statistical methods in archeological studies has a fairly long history at the international level, especially

in terms of using the techniques of interdisciplinary sciences and statistical methods to quantify the results of archaeological findings, becoming especially common after the advent of the New Archaeology of the 1960, the use these sciences, especially statistical science, does not have a long history in Iran's archeology; it has been emphasized greatly in recent years, however, and a remarkable number of studies have been conducted based on such methods. One of the authors of the present study (M. H. Azizi Kharanaghi) has devoted a part of his MA thesis to this subject. It seems that in prehistoric periods, i.e. the eras before writing, the forms and designs which were produced on different forms of pottery included special information and messages in addition to their decorative and aesthetic purposes. Thus, producing different forms of pottery and creating special designs for decorating the ceramics, particularly in prehistoric cultures of the fifth millennium BC in Fars (Bakun Culture) can be studied in this regard. The examinations and analyses carried out by statistical methods, which are discussed in details in the present study, indicated a direct significant relationship between form of potteries and the design motifs found on them. In the four standard and common types of ceramics of the Bakun Period at Toll-e Rahmatabad, some special designs are more frequently found on particular vessel forms, which prove the results of the present study.

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