



## Surveying the impact of climate and geographical context on house phenotypical typology (case study: Sistan & Gonbad)

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### ABSTRACT

*This study involves surveying the impact of climate factor and geographical context on Sistan housing phenotypical typology in two different geographical contexts (Zabol & Gonbad) via formal (phenotypic) typology indexes. To determine the desired wish, 56 houses of three Sistani clans and 21 houses of Sistani immigrants resided in Gonbad were selected in a targeted way. From each sample, phenotypical information was gathered by taking the precise plan of houses, observing, and taking photos. Then, based on valid sources, three formal criteria (construction pattern, physical pattern, and components/details) were selected. In the next stage, paralleled to the above measures, the findings were inputted the SPSS Software, Version 22, in order to specify the phenotypical differences in the houses of the two climates; and the ANOVA Test was applied to compare the average of statistical analysis criteria.*

*The research findings indicate that by changing the context (from Sistan to Gonbad) climate differs, but despite the change in climate, phenotype does not change; therefore, the ability of the residents in adapting with the environment causes doubt about the outcomes of the phenotypical typology analysis, only based on physical factors (climate, geographical position, materials, and technology, etc.). Hence, to give more validity to typology analysis, it is proposed to survey the impact of culture on house framework, too.*

**Keywords:** Geographical Context-Typology-Phenotype-culture-adaptation.

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### INTRODUCTION

Typology is a crucial issue of architecture in the contemporary era that always has drawn the attention of different researchers (Memarian 1386, Raheb 1392, Moqtadaee 1385, Santamouris 2014, Alpine 2007, Lambertz 2013, Oktay 2001, Hacker 2007). Types have some features which are changeable. Different factors are effective on changing the features. Different types can gradually acclimatize to changes in environment, and change of environmental conditions can generate new kinds of them. Struggle and survival are effective in natural selection, generation of new types, and their reproduction and gradual change (Sahabi 1351). Appearance or body of a phenotype being in architecture is the framework of a building that shows itself in the form of a type which is the result from the operation of different factors. We can point to factors such as physical situation, weather conditions, social cultural status, and the perception of individuals about the concept of life style. Considering the effective factors on house form and framework, different phenotypical typologies are presented. A group of researchers believe house typology based on environmental/formal factors (Habibi et al 1360, Alalhesabi 1372, Academic Center of Shid Beheshti University 1378, consulting engineers of architecture process 1378, Tarkashvand, Raheb 1390, Taheri & Xodabandeloo 1385, K R Uni 2007, Oliver 1969, Rapoport 1965). In this viewpoint, the major issue is the environmental factors (including natural and human environment) and their effect on house as the result of

interaction or contrast of above-mentioned factors. This approach looks for separating the effective factors on house formation, comparing the effect rate of every factor on creation of types, and finally house classifying based on the effective factor or the most effective factors.

Another group of researchers classify the house typology based on historical phenomenology (Memarian 1384, Krier 1380, Memarian 1373, Memarian 1386, Kataldi 1368).in this viewpoint house type is the initial point of a prototype, and the origin of what exists now, is looked for in this type. The main pivot in this route is cognition and reconstruction of the initial chain up to the current one that according to this theory will cause the continuity between past and present (Memarian 1384). Following the discovery of prototype, physical growth of a type will be surveyed within the framework of the resource construction, space, structure, and form (Memarian 1384).

Another group knows typology based on the problem solution (Fathi 1372, Haeri 1388, Alexander 1381, Alexander 1977). In this approach, what is known important in identifying the house types is the presented strategy for solving the problem of residence choice. This issue covers all physical and non-physical aspects effective on human biology, and what is original is the solutions that man has selected for it and modified. Therefore, we can regard some part of the function of the pattern in explaining the criteria related to typology of architectural spaces and forms.

The rate and kind of the resulted sharing from following the common pattern, commensurate with the scale and kind of interfering pattern in design creation, is assessable (Sultani 1391).

Paying attention to the views resulted from the proposed approaches, the most important aspects explored about type are: physical factors like climate (weather conditions, etc.), need to shelter, materials and construction technology, position, and economical/military/religious aspects. The objection to these factors is this that all of them are influenced by physical force and they attribute the building shape to a single factor, and consider climate as the most important factor in formation of the type; while a building results from the interaction of numerous complicated components and factors. Moreover, we know that climate and geographical context have different factors upon which they create various environments that affect the surrounding and house. In other words, the role of climate in the processes of type creation and its divisions is the ultimate goal of all these attempts. This point that how climate defines the types in direct relationship with its content, and how it extends indicate the major role of this issue among the architectural research issues. However, from the viewpoints of these researchers-in formation of 'type' or 'stereotype' or 'barrier type' or 'freezing type'-context or climate can clarify the physical aspects of a building (De Carlo 1985).

On the other hand, according to Rapoport (1969), among the physical and cultural factors mentioned in creation and formation of the house, the cultural ones have the more significant impact (Rapoport 2005, Scott 2005, Wicker 2012). Since the local and traditional houses are the direct and unconscious translation of needs, values, tendencies, and instincts related to a nation into their cultural language. Researchers like Eliore (2007) and Husker (2007) believe that 'type', in its theme, is an attempt for establishing a causal relationship between human society and architectural framework, a relationship that is looking for a strategy to describe 'phenotype', a description that can discover the hidden logic in underlying layers.

In other words, phenotype is formed from framework-behavior that are defined by given places and time, and its physical/human components act in an organized way (Barker 1968, Wicker 1979). Therefore, societies are different not only in the type of spatial components, but also in type of house physical typology, as a noted cultural aspect of spatial configuration (Levi 2009, Karlen 2009, Strauss 1967).

Additionally, the results of some studies show the conformity of architectural type from social framework (Memarian 1381, Hilier. Hanson. Orham 1995, Wineman et al 2006, Memarian 1384, Krier 1380, Memarian 1373, Memarian 1386, Kataldi 1368, Rapoport 1990), and also they indicate that social cultural structures clarify physical and qualitative aspects; because culture specifies the features of residential surroundings (Rapoport 1969). So, they (Rapoport 1969, Oliver 2007) know house typology as the result of interaction or contrast of social cultural factors.

However, the new types of house, in a region with an accepted cultural group, do not have different phenotypes; so that they have formed the fixed types of house (Sistani people's houses, and houses for the Sistani immigrants in Gonbad). Noticing the mentioned theories, different typologies of housing should have different phenotypes; however, the residents who are the members of a cultural group and have equal legalities should have similar phenotypes. These observations, inconsistent with the approach based on environmental/formal factors, caused this study to look for the relationship between climate and phenotypical typology. To reach this goal, the following primary and secondary questions are posed:

- What effect do climate change and geographical context have on housing phenotype of a cultural group?
- Which one of the phenotypical features of Sistani housing in Gonbad has been different?

-Among the effective factors on housing, which factor has had the most effect and has been determinant? (Hypothesis assertion).

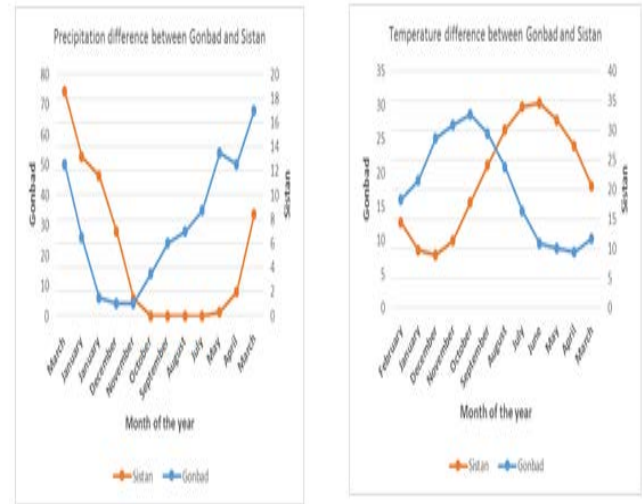
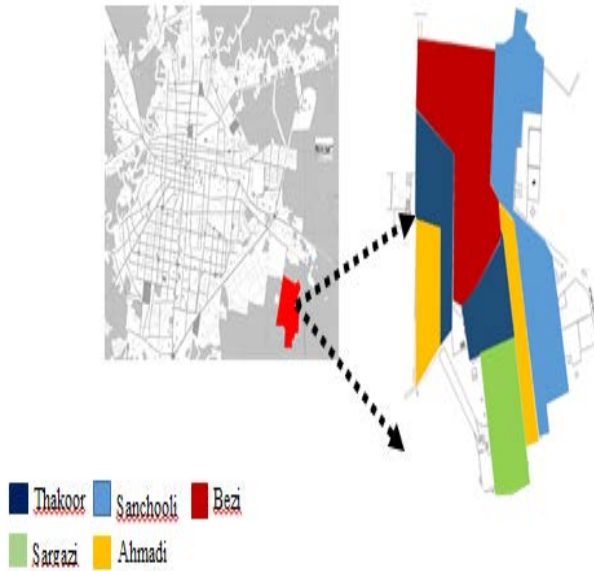
## RESEARCH METHOD

The statistical population of Sistani people's housing was selected in two different context and climate, i.e. Sistan representing the dry & warm climate, and Gonbad representing the mild & warm climate (Figure 3c). The criteria of selecting these two contexts in the statistical population were: very few studies on architecture and culture of the region and nation; availability of the needed data and the ability of gathering the research data more easily (due to this fact that the researcher was a member of statistical population members). Moreover, because of the extension and spread of the field under investigation, and impossibility of surveying the entire area of Sistan, a more limited population should have been selected as the statistical population. In the same vein and based on the theories and studies, at the time of selecting the statistical population, the variable of clan as one of the effective factors on content structure was controlled. Three clans of Bezi, Sanchooli, and Thakoor were selected to be studied (Figure 1a); the residing places of these tribes were at 9 villages (village of Thakoor, village of Dah Mirkhan, village of the Upper Dah Bazzi ( Khalesi Bazzi), village of the Lower Dah Bazzi, village of Zolfaghari, village of Haji Abad Khoshdad (old Khoshdad), village of new Khoshdad, village of Islam Abad, village of Sedif) in Sistan area, and in different towns of Hamoon, Hirmand, and Nimrooz as the areas selected. These villages were proposed by the Elders of the clans who were interviewed. The villages have various enough rural houses for this study.

Furthermore, village of Zaboli Abad in Gonbad town, which is located in center part and rural district of Fajr was selected as an immigration village. After outbreak of drought in Sistan area, some people immigrated to North part of the country, to Gonbad and villages around. Zaboli Abad is one village which was the destination of the immigrants. Locations of the areas under study in two cities of Sistan and Gonbad are specified in Figure 1.



Figure 1. Establishment of villages under study in Sistan



**Figure 2. Gonbad Kavooos town & village of Zaboli Abad, and the settlement way of Sistani clans in Zaboli Abad**

Then, in order to do phenotypical distinctions, after field study, based on three criteria of "Construction Pattern", "Physical Pattern", and "Components & Details", we got involved in classifying the available houses. In this regard, 56 houses of local houses in the region under study, and 21 houses of Sistani immigrants in Gonbad were sampled in a targeted way, and then they were classified based on the intended criteria. By precise drawing of housing plans, observing, and taking photos, phenotypical information was gathered from each sample.

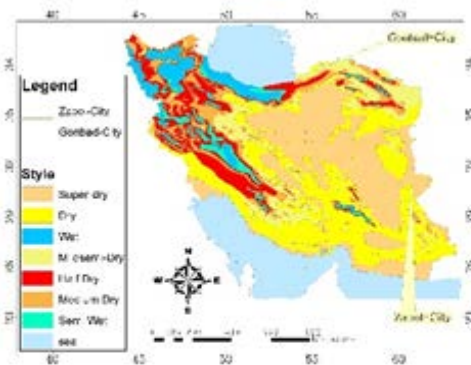
**Instruments**

To find out the impact of context and climate on phenotypical typology of the intended houses, the following instruments were used:

The method of this research is qualitative and based on library studies as well as field study. In field studies, targeted sampling was used. Research instruments, observations, and interviews were provided based on the intended criteria. Preparation of photos, plans, and maps was also done.

**The research steps are as follows:**

The first step is zoning the two intended contexts based on climate factors effective on house creation, so that we can predict climate and possibility of house types, based on that. To do so, the most important climate indexes, which were effective on creation of house in two contexts, were compared to each other. In this way, by comparing the difference in temperature and annual precipitation, and its overlap with GIS information layers, climate zoning of the two contexts was specified (Figure 3c).



**Figure 3---Temperature difference of the two regions under study. A. Chart of precipitation difference, B. Chart of temperature difference, C. Map of geographical context**

In the next step, paralleled to above measures, and to specify the phenotypical differences of houses in the two climates, the findings are input to SPSS software, version 22, and to compare the average of the criteria, Statistical Analysis (ANOVA) Test was used.

Then, by an analytical approach, the results of two previous sections were compared as the following: prediction and perception of the researcher about the probability of the types, based on the current condition and the intended criteria (construction pattern, physical pattern, components/details) in order to match the results in the two desired contexts in which regarding the type formation process and their phenotype, noticing the intended approach and its cause-finding, there were meaningful information. The obtained result was recognition of each intended criterion in formation of types in the two contexts. In the next step, considering the obtained data from the two geographical contexts, we paid attention to the relationship within the phenotypes of the two contexts, and derived its conclusions. By gathering the entire obtained information, phenotypical criteria of house type were identified.

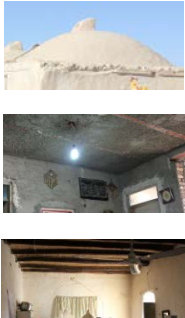


**DATA & RESULTS**

So far, different indexes have been used by researchers for morphological typology of houses (Tasnimi et al 1389, Sartipipoor 1392, Research Center of House and Building 1363, Raheb & Habibi 1393). In this study, the indexes of formal (phenotypical) typology were selected based on these valid sources that include construction pattern, physical pattern, and components/details. According to these three criteria and their




sub-criteria, 56 local houses of Sistan, and 21 houses of Sistani immigrants, were surveyed.

**Construction Pattern**

In tables 1, you can see sub-criteria of construction pattern (ceiling type, materials and view) in two regions of Sistan & Gonbad.

sub-criteria	Construction Pattern														
Sample pictures															
sub-criteria	Ceiling Type				Construction material					Facade material					
Types	Roof beat	Block Joist	Dome	Wood beam	spar-adobe	Brick	Wood	Block	Stone	Cement	Brick	Stone	Thatch	incomplete	
Frequency	46	1	19	6	30	54	0	23	0	47	13	1	30	2	

**Table 1-1 frequency of samples in Sistan considering the sub-criteria of construction pattern**

sub-criteria	Construction Pattern														
Pictorial sample															
sub-criteria	Ceiling type				Construction material					Facade material					
Types	Roof beat	Block Joist	Dome	Wood beam	Adobe	Brick	Wood	Bloc	Stone	Cement	Brick	Stone	Thatch	Unfinished	
Frequency	2	19	0	0	0	20	0	2	2	15	7	9	0	0	

**Table 1-2 frequency of samples in Gonbad considering the sub-criteria of construction pattern**

In tables 2, you can see sub-criteria of physical pattern (mass form, settlement in the curtilage-floor numbers, room numbers) in two regions of Sistan & Gonbad.

**2-Physical Pattern**

sub-criteria	Physical Pattern													
sub-criteria	mass form					settlement in the curtilage					floor numbers		room numbers	
Types	L	U	Centered	Parallel	Linear	One way	Two-way	Three-way	Peripheral	Middle	1	>	3	>
Pictorial sample														
Frequency	12	6	27	3	8	28	15	6	2	5	56	0	8	48

Table 2-1 frequency of samples in Sistan considering the sub-criteria of physical pattern

sub-criteria	Physical Pattern													
sub-criteria	mass form					settlement in the curtilage					floor numbers		room numbers	
Types	L	U	Centered	Parallel	Linear	One way	Two-way	Three-way	Peripheral	Middle	1	>	3	>
Pictorial sample														
Frequency	2	0	16	2	1	12	5	2	0	2	17	4	5	16

Table 2-2 frequency of samples in Gonbad, considering the sub-criteria of physical pattern

**Components & Details**

In tables 3 you can see the frequency of sub-criteria in components/details (stairs-material of stairs-door material-windshield-window material-windshield-window material-number of windows)

sub-criteria	Components & Details									
Pictorial sample										
sub-criteria	Stair			Door		windshield			Window	
Types	material	internal	external	material	one way	two ways	multi ways	material	number	
Features & frequency	brick-cement-adobe-cob-structural beam-iron-wood-plastic	0	11	Iron & wood	16	0	0	cover-glass cover-plastic	from zero to 9 windows	

Table 3-1 frequency of samples in Sistan, considering the sub-criteria of components/details

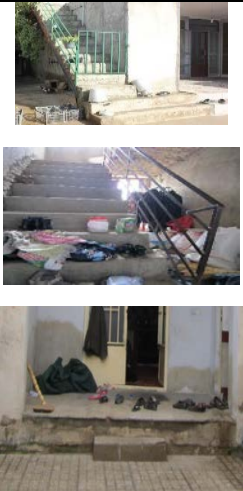


sub-criteria	Components & Details									
Pictorial sample										
	Stair			Door		windshield			Window	
	Types	material	inter nal	exte rnal	material	one way	two ways	multi ways	material	number
Features & frequency	Brick-cement-mosaic-stone-concrete-structural	3	15	Beam-iron-aluminum-wood	0	0	0	iron-aluminum	from 1 to 7 windows	

Table 3-2 frequency of samples in Gonbad, considering the sub-criteria of components/details

Concerning the frequencies in all three criteria of construction pattern, physical pattern, and components/details, these data are analyzed statistically by SPSS software. For this kind of analysis, variance analysis (ANOVA) is used. one-way variance analysis (ANOVA) is one of frequently used analyses that is applied in all sciences. In simple words, it can be said that if we have 2 groups or more than 2, and want to compare the score of one variable in these groups, we use this test. The results of this analysis can be found in table 4.

Space name	F value	Freedom Degree	Significance Coefficient
Ceiling	3.258	58.695	0.002(*)
Construction Material	6.320	55.043	0.000(*)
View Material	2.987	56.913	0.004(*)
Plan Shape	-0.867	53.629	0.390(No)
Settlement	0.426	75	0.671(No)
Story/Floor	-2.169	20	0.042(*)
Room	0.987	75	0.327(No)
Stair/step	4.188	75	0.000(**)
Stair Material	-1.893	27	0.069(No)
Door Material	-2.310	75	0.024(*)
Windshield	4.690	55	0.000(**)
Window Material	-3.092	73	0.003(**)
Window number	0.522	75	0.603(No)

(\*\*) Significance in level 99 percent (\*) Significance in level 95 percent lack of significance

Table 4: comparison of 3 criteria (construction pattern, physical pattern, and components/details) in 2 societies of Sistan & Gonbad, using the Independent F Test.

Concerning the above-mentioned test in which we surveyed the intended criteria via ANOVA Parametric Test, the obtained results indicate this issue that the majority of measured components have the significance level of 95 to 99 percent; this point indicates that among the indexes of ceiling, material, view, stair, and windshield in 2 societies of Sistan & Gonbad, concerning the indexes of building construction and building there is a relationship. This shows that there is a relationship between geographical context and climate. This point indicates that the houses of the residents who live in Gonbad are different from the residents who live in Sistan, concerning these indexes. But the components of plan shape, room, settlement, window number, stairs, and stair material show lack of significance. The reason for this can be the relationship between house and culture as an effective criterion. According to this issue, the main factor effective on house type is the culture of that region which has not been changed by the immigration of its residents and they form the new house very close to the original shape.

**Discussion & conclusion**

Typology of Sistani local houses and the houses of Sistani immigrants to Gonbad was done using effective criteria on house type, including construction pattern, physical pattern, and components/details. Noticing the climate change (from Sistan to Gonbad) it seems that these houses did not have any change phenotypically. Since by paying attention to the obtained statistical analyses, we see that there is significant difference in some sub-criteria such as ceiling, construction materials, and view materials which are related to construction pattern. On the other

hand, we know that the construction criteria depends on the used technology in the place, and is totally temporal, i.e. by the passage of time, the use of past technologies have got obsolete in house construction. Therefore, this difference in the house of 2 climates is related to temporal aspect and cannot be a considerable factor. Additionally, sub-criteria of windshield and window material can also be ignored in analysis and conclusion based on the same temporal reason. For example, windshield is not used now in the new houses of Sistan, as the basic component that was used in the past.

Furthermore, the main factors determining the house form and framework in the two climates, are the physical sub-criteria (plan form-settlement way-and room number) that regarding the performed analyses in the housing of the two climates, do not have significant difference from each other, and they were equal in both regions of Sistan & Gonbad. The window number (opening form) is also very effective on the form and framework of the local houses; but this one also has not changed in houses of the 2 climates.

It is concluded that phenotypical typologies that are performed only based on climate and geographical context, do not have a high degree of honesty, and phenotype alone cannot be the criterion for house typology. Therefore, these conclusions have rejected the local researches performed concerning the phenotypical typology of housing, and mere attention to climate and geographical context, and actually they confirm Rapoport discussions concerning the culture factor as an effective criterion on house form. According to this, the major factor effective on house type is the culture of the region that has not been changed by immigration of its residents to a new place, and forms the new house very similar to the original one. In other words, all physical factors (climate, materials and technology...), initially, pass the culture filter of immigration group, and then, are applied in new climate. Hence, these physical factors affect form and framework of housing in the second position (after culture), and immigrants give cultural replies to new climate.

In future researches, the effect of culture on house is expected to be surveyed by Space Social logic Theory and Space Syntax, so that, the hidden biological pattern that does not change by immigration of culture groups to new place, is discovered.

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