IDENTIFICATION OF VARIABLES FOR THE FUTURE PLANNING AND DEVELOPMENT OF ALIGARH MUSLIM UNIVERSITY

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Abstract- *Aligarh Muslim University, an institution with 'Heritage Character' is losing its historic identity because of the fast pace of development of modern structures which are nowhere compatible in architecture and planning with the century old architectural marvels. The paper is an extract of research which identifies the variables which were there in the buildings and complexes at AMU for more than hundred years and were suddenly lost with the growth of the institution. Guidelines were developed to incorporate these variables again to rejuvenate the Heritage Character of Aligarh Muslim University.*

Keywords: Heritage, Conservation, variables.

1. INTRODUCTION

Aligarh Muslim University is encompassing a strong sociocultural Identity. Established in 1875 as Mohammedan Anglo Oriental College, the institution got the status of Aligarh Muslim University in 1920 through an act of parliament of India. Having a strong educational identity, Aligarh Muslim University is also famous for its unique architectural character, commonly known as 'Aligarh Style of Architecture'. This style of construction of buildings which was evolved in 1875 is an amalgamation of Mughal and British architecture which is unique in itself.
'The buildings have monumental scale and exposed brick external walls with arcaded openings. Different varieties of arches are found in the buildings of the campus, which are either of bricks or of sandstone, with square or circular pillars, which are beautifully carved. The door and window openings are having glass on them with chajja projections supported by stalactite brackets at some places. In addition to this, the mullion on the parapet and a lot more is there which make these buildings different in style and character.' Single and double story structures with high rooms at the back and low height verandah at front. Wide courtyards give proper light and air circulation. Corridors were also used as multifunctional space and worked as buffer zone between pathways and rooms. [1]
The expansion which had taken place due to the growth of department and faculties in the last four decades have resulted in haphazard development in terms of architecture and planning in the campus. This has resulted in the reduction of variables which were there in the earlier buildings of the campus. This reduction in the number of variables have resulted in the development of 'match box' like structures in the campus, due to which the 'Heritage Character' of the campus is getting threatened. These variables are identified and the guidelines for future planning and development in the campus have been provided to revive the century long Heritage Character of the campus.

2. SIGNIFICANCE OF VARIABLES

For conducting this research the variable which are commonly found in most of the Heritage Buildings of national importance were identified through literature and field visit. After the study Thirty five variables were selected for doing this study. There were still more variables which can be there in heritage buildings in India but the study was conducted on selected thirty five variables. These variable were categorized under four broad parameters ie. Influence, Principles, Elements and Ornamentation. A Pilot survey was done to check whether the variables selected for the conduct of this study are significant or not.
This Pilot Survey was conducted on forty Professionals in the field of Heritage Building Conservation for grading these variables on I-V scale. Freedom was given to them for suggesting some more variables and to provide suggestions if any.
The pilot survey comprises the Conservation Architects which were independently practicing in the field, the professionals working in the Conservation organizations like Archaeological Survey of India (ASI), Indian National Trust for Art and Cultural Heritage (INTACH), Aga Khan Trust for Culture (AKTC), Heads of various Conservation organizations like Dharohar, Heritage Restore, Conserve Heritage, Director of National Institute of Advance Studies in Architecture (NIASA) 'the Education Wing of Council of Architecture' and Heads & senior

Faculty members of few academic institutions like Jamia Millia Islamia New Delhi, Aligarh Muslim University, RIMT-COA Gobindgarh , Amity University Lucknow etc.

A questionnaire was prepared and was send to forty conservation professionals and academicians asking them to scale thirty five variables selected from the Heritage Buildings in India on a scale of I-V, where V is the most significant and I is the least significant scale.

These thirty five variables were categorized under four broad parameters ie. Influence, Principles, Elements and Ornamentation for the conduct of study. Questionnaire of Pilot Survey is as below:

Pilot Survey Questionnaire for Heritage Buildings

Name: Sangeeta Bais	Designation: Head
Organization: Dharohar	Email:sangeeta.s.bais@gmail.com

Below are the list of Variables significant in Heritage Structures and Complexes in India. Please scale these variables on a scale of I-V according to their importance in heritage buildings. Also suggest more variables which you think are significant in heritage structures.

S.No.	Parameter		Variable	*Scale the Variable				
				I	II	III	IV	V
1.	Influence	1	Climate	*				
2.		2	Regional Architectural		*			
3.		3	Typology-Residential etc.			*		
4.	Principles	1	Axis			*		
5.		2	Symmetry			*		
6.		3	Proportion			*		
7.		4	Grand Scale			*		
8.		5	Courtyard Planning		*			
9.		6	**Viewshed or Vista		*			
10.		7	Geometric Planning		*			
11.	Elements	1	Boundary Wall			*		
12.		2	High Plinth			*		
13.		3	Foundation Stone			*		
14.		4	Landscaping		*			
15.		5	Built open Relationship			*		
16.		6	Green Lawns					*
17.		7	Stone Cladding		*			
18.		8	Exposed Brick				*	
19.		9	Arches	*				
20.		10	Columns	*				
21.		11	Eave projection and louvers				*	
22.		12	Brackets	*				
23.		13	Colonnaded Veranda	*				
24.		14	Parapet Wall	*				
25.		15	Domes	*				
26.		16	Chatris and Cupolas	*				
27.		17	Minarets	*				
28.	Ornamentation	1	Cornices and Corbelling	*				
29.		2	Monolithic Screen (Jali)					*
30.		3	False Arch	*				
31.		4	Stone Carving	*				
32.		5	Pilaster				*	
33.		6	Inlay Work			*		
34.		7	Calligraphy	*				
35.		8	Paintings and Sculptures		*			

TABLE I -DESCRIPTIVE STATISTICS (SPSS 20)

Variable	Variable Code	N	Minimum	Maximum	Mean	Std. Deviation
Proportion	PRPR	40	2.00	5.00	4.0500	.87560
Built Open Relationship	ELBO	40	2.00	5.00	4.0250	1.04973
Monolithic Screen (Jali)	ORMS	40	2.00	5.00	3.9500	.87560
Regional Architecture	INRA	40	2.00	5.00	3.9250	.88831
Arches	ELAR	40	1.00	5.00	3.9250	1.14102
Climate	INCL	40	1.00	5.00	3.9250	1.32795
Stone Carving	ORSC	40	1.00	5.00	3.9000	1.08131
Column	ELCO	40	1.00	5.00	3.8500	1.05125
Chatris and Cupolas	ELCC	40	1.00	5.00	3.8000	1.06699
Paintings & Sculptures	ORPS	40	1.00	5.00	3.7750	1.16548
Landscaping	ELLS	40	2.00	5.00	3.7750	.76753
Inlay Work	ORIW	40	2.00	5.00	3.7750	.91952
Symmetry	PRSY	40	1.00	5.00	3.7250	1.15442
Brackets	ELBR	40	1.00	5.00	3.7250	1.03744
Domes	ELDO	40	1.00	5.00	3.7250	1.13199
Cornices and Corbelling	ORCC	40	1.00	5.00	3.7000	1.09075
Calligraphy	ORCA	40	1.00	5.00	3.6750	1.18511
Axis	PRAX	40	1.00	5.00	3.6750	1.26871
Grand Scale	PRGS	40	2.00	5.00	3.6250	1.00480
Vista	PRVI	40	1.00	5.00	3.6250	1.23387
Minarets	ELMI	40	1.00	5.00	3.5750	1.15220
High Plinth	ELHP	40	1.00	5.00	3.5250	1.19802
Geometric Planning	PRGP	40	1.00	5.00	3.5000	1.32045
Typology	INTY	40	1.00	5.00	3.5000	1.03775
Colonnaded Veranda	ELCV	40	1.00	5.00	3.4500	1.03651
Eave projection & Louvers	ELEP	40	1.00	5.00	3.4500	1.10824
Pilaster	ORPI	40	1.00	5.00	3.4500	1.08486
Courtyard Planning	PRCP	40	1.00	5.00	3.3250	1.11832
Parapet Wall	ELPW	40	1.00	5.00	3.2500	1.12660
Foundation Stone	ELFS	40	1.00	5.00	3.2500	1.25576
Stone Carving	ELSC	40	1.00	5.00	3.2000	1.06699
Boundary Wall	ELBW	40	1.00	5.00	3.1750	1.17424
False Arch	ORFA	40	1.00	5.00	3.1000	1.12774
Green Lawns	ELGL	40	1.00	5.00	2.9750	1.16548
Exposed Brick	ELEB	40	1.00	5.00	2.8000	1.01779

RESULT OF MEAN

The mean of all the forty respondents is analyzed with the help of SPSS 20 software. The result shows that the mean of all the forty responses for these thirty five variable was between 2.80 to 4.05 on a scale of 5. Which implies that the variables were having significance between 56% to 81%. Since the mean of all the individual variable taken from the heritage buildings for the analysis was more than 50%.

This justify that **"All these thirty five variables contributes significantly in the Heritage Buildings of India".**

3. FACTOR ANALYSIS OF VARIABLES

Factor analysis or Principle Component Analysis is the multivariate technique use for large data set. It is a technique applicable when there is a systematic interdependence among a set of variables and the researcher is interested in finding out the something more fundamental or latent which creates this commonalities.

After doing the correlation analysis we find out that though all of them are significant in heritage buildings but few variable out of these thirty five are showing strong correlation with the other variables. These variables (INRA, PRAX, ELBR, ELDO, ELMI, ORSC) are neglected since they are influencing the other variables and rest of the variables are taken for factor analysis.

After analyzing the mean, it is found that all the thirty five variable selected for research are important for the heritage buildings in India. But by factor analysis the percentage of variance of variable can be identified for undertaking further research.

Hypothesis formulated is as under:

H_0: *All the variables are equally important in the heritage buildings.*

H_1: *All the variables are not equally important in the heritage buildings.*

Table II - Acceptance and Discard of Variables on the basis of Correlation

S. No.	Variable Code	Variable Name	Accepted or Discarded
1	INCL	Climate	Accepted
2	INRA	Regional Architectural	**Discarded due to strong correlation with other variables**
3	INTY	Typology	Accepted
4	PRAX	Axis	**Discarded due to strong correlation with other variables**
5	PRSY	Symmetry	Accepted
6	PRPR	Proportion	Accepted
7	PRGS	Grand Scale	Accepted
8	PRCP	Courtyard Planning	Accepted
9	PRVI	**Viewshed or Vista	Accepted
10	PRGP	Geometric Planning	Accepted
11	ELBW	Boundary Wall	Accepted
12	ELHP	High Plinth	Accepted
13	ELFS	Foundation Stone	Accepted
14	ELLS	Landscaping	Accepted
15	ELBO	Built open Relationship	Accepted
16	ELGL	Green Lawns	Accepted
17	ELSC	Stone Cladding	Accepted
18	ELEB	Exposed Brick	Accepted
19	ELAR	Arches	Accepted
20	ELCO	Columns	Accepted
21	ELEP	Eave projection and louvers	Accepted
22	ELBR	Brackets	**Discarded due to strong correlation with other variables**
23	ELCV	Colonnaded Veranda	Accepted
24	ELPW	Parapet Wall	Accepted
25	ELDO	Domes	**Discarded due to strong correlation with other variables**
26	ELCC	Chatris and Cupolas	**Discarded due to strong correlation with other variables**
27	ELMI	Minarets	**Discarded due to strong correlation with other variables**
28	ORCC	Cornices and Corbelling	Accepted
29	ORMS	Monolithic Screen (Jali)	Accepted
30	ORFA	False Arch	Accepted
31	ORSC	Stone Carving	**Discarded due to strong correlation with other variables**
32	ORPI	Pilaster	Accepted
33	ORIW	Inlay Work	Accepted
34	ORCA	Calligraphy	**Discarded due to strong correlation with other variables**
35	ORPS	Paintings and Sculptures	Accepted

The Principal Components Method of Factor Analysis

Principle Components (PC) analysis is a procedure to convert a set of observations of possibly correlated variables into a set of values of linearly uncorrelated variables called principal components. This transformation is defined in such a way that the first principal component accounts for the largest variability in the data, and each succeeding component in turn has the highest variance possible under the constraint that it is uncorrelated with the preceding components.

The PC analysis for the variables selected after the correlation is done through SPSS 20 which provides the Kaiser-Meyer-Olkin Measure of Sampling Adequacy shown in the table V. This is the measures of appropriateness of Factor Analysis.

Table III - KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	.628
Approx. Chi-Square	777.717
Bartlett's Test of Sphericity df	378
Sig.	.000

Interpretive adjectives for the Kaiser-Meyer-Olkin Measure of Sampling Adequacy are: in the 0.90 as marvelous, in the 0.80's as meritorious, in the 0.70's as middling, in the 0.60's as mediocre, in the 0.50's as miserable, and below 0.50 as unacceptable. The value of the KMO Measure of Sampling Adequacy for this set of variables is .628, which would be labelled as 'middling'.

Since the KMO Measure of Sampling Adequacy meets the minimum criteria, we do not have a problem that requires us to examine the Anti-Image Correlation Matrix.

Therefore the Factor Analysis was done through SPSS 20 which provides the principle components PC-I, PC-II, PC-III and the total percentage of Variance explained by Rotated component. It also provides the cumulative percentage of Variance explained by Rotated component.

Table IV -ROTATED COMPONENT MATRIX

S.No	Variable Code	Variable	Principle Components		
			PC-I	PC-II	PC-III
1	INCL	Climate	.310	-.711	.205
2	INTY	Typology	.406	-.305	.208
3	PRSY	Symmetry	.502	-.116	.545
4	PRPR	Proportion	.539	-.355	.300
5	PRGS	Grand Scale	.545		.279
6	PRCP	Courtyard Planning	.664	-.173	-.376
7	PRVI	Viewshed or Vista	.553	.172	.434
8	PRGP	Geometric Planning	.475	-.267	.270
9	ELBW	Boundary Wall	.549	.353	.264
10	ELHP	High Plinth	.589		.381
11	ELFS	Foundation Stone	.571		.195
12	ELLS	Landscaping	.581		.317
13	ELBO	Built Open Relationship	.425	-.225	.399
14	ELGL	Green Lawns	.150	.694	
15	ELSC	Stone Cladding	.587	.441	.144
16	ELEB	Exposed Bricks	.475	.548	-.270
17	ELAR	Arches	.760	-.238	-.368
18	ELCO	Columns	.671	-.390	-.331
19	ELEP	Eave Projections and Louvers	.484	-.145	-.141
20	ELCV	Colonnaded Veranda	.548		
21	ELPW	Parapet Wall	.628		-.340

22	ORCC	Cornices and Corbelling	.753		-.227
23	ORMS	Monolithic Screen	.616	.414	-.189
24	ORFA	False Arch	.640	.386	-.438
25	ORPI	Pilaster	.606	.146	-.320
26	ORIW	Inlay Work	.740	.131	
27	ORPS	Paintings and Sculptures	.622	-.378	.283
		Percentage of Variance	**33.326**	**9.921**	**8.640**
		Cumulative Percentage	**33.326**	**43.246**	**51.886**

Extraction Method: Principal Component Analysis.

The values selected from these PC's should not be less than .5. PCI contributes 33.3% of the variance in the data set, it comprises of Arches and Cornices & Corbelling, PCII contributes 9.9 % of the variance in the data set and it comprises of Climate & Green Lawns, while PCIII contributes 8.6 % of the variance in the data set and it comprises of Symmetry. These five variables of PC I, PC II and PC III together contributes 51.886% of variance in the data set.

This implies that **"Although the thirty five variables which were selected from heritage buildings are significant but these five variables from among them are the most important and significant variables. These five variables are contributing 51.8% in the selected thirty five variables".**

Null Hypothesis H$_0$ is rejected on the basis of statistical analysis carried out.

4. IDENTIFYING VARIABLES AT ALIGARH MUSLIM UNIVERSITY BUILDING

The above analysis shows that all the variables were significant and important in the Heritage Buildings at national level, but out of these thirty five variables, five variables are contributing 51.8% in the whole matrix. Since Aligarh Muslim University is having a Heritage Character, these Variables are then tested in the buildings of the campus. This test was conducted on seventy nine buildings and complexes of the Aligarh Muslim University campus. For conducting this research a chronological study of the building construction in the campus was done. Buildings from each decade from the time of establishment till date are taken and the variables were examined in these buildings. A table of buildings along with identified variables is given below.

Table V- Variables in Buildings of Aligarh Muslim University

S.No	Name of The Building	Age	Variables
1	Mohammadgarh Aligarh fort	1524	27
2	Provost Office Sir Shah Sulaiman Hall	1803	22
3	Guest House No-2	Bef.1875	26
4	Sir Syed House	1870	23
5	Teaching Staff Club	1876	21
6	Sir Syed Hall	1877	34
7	Strachey Hall	1877	32
8	Lytton Library	1878	30
9	Mushtaq Manzil	1879	28
10	Mehndi Manzil	1879	28
11	Jama Masjid	1879	34
12	Victoria Gate	1885	31
13	Khalifa Syed Mohammad Hasan Gate	1885	27
14	Henry Laurence Gate	1885	27
15	Hamidullah Khan Lecture Theatre	1886	28
16	Nizam Museum	1887	31

17	Asman Manzil	1888	29
18	Tasadduq Ali Khan Lecture Theature	1888	28
19	Department of Islamic Studies	1892	26
20	Morrison Court	1894	31
21	Wallace Cricket Pavilion-Willingdon Cricket Club	1897	24
22	Back Manzil	1899	28
23	Mac Donells	1902	33
24	Centre for Adult Education	1903	23
25	University Health Service	1903	23
26	Mumtaz Hostel	1904	31
27	Student's Union Hall	1905	30
28	Proctor's Office	1905	23
29	Syedna Tahir Saifuddin High School	1908	33
30	Waheed Jahan Hostel-Old Wahidia Hostel	1911	24
31	Old Boys Lodge	1912	28
32	Faculty of Theology	1912	25
33	Centre For Women's Studies	1912	22
34	Sultan Jahan Manzil-Sultan Jahan Coaching Centre	1914	29
35	Meston Swimming Pool	1915	31
36	Sultan Jahan Hostel, Abdullah Hall	1916	24
37	Faculty of Theology	1910's	27
38	Post Office	1919	23
39	Department of Mass Communication	1920,s	25
40	Abdullah Nursery School	1923	24
41	Vikarul Mulk Hall	1925	31
42	Biochemistry Department	1926	32
43	City School	1927	23
44	Moinuddin Ahmad Art Gallery	1928	25
45	Department of Education	1929	26
46	Institute of Persian Research	1930	25
47	Department of Foreign Language	1930	26
48	Aftab Hostel	1930	32
49	Prince of Wales Zoological Laboratory	1932	29
50	Prince of Wales Chemical Laboratory	1932	29
51	Prince of Wales Botany Laboratory	1932	29
52	Ajmal Khan Tibbiya College	1941	26
53	Zakir Husain College of Engineering and Technology	1946	28
54	Department of Civil Engineering	1950's	22
55	Maulan Azad Library	1955	27
56	University Boys Polytechnic	1957	23
57	Kennedy Complex	1959	27
58	Arts Faculty	1961	27
59	Jawahar Lal Nehru Medical College	1969	26
60	Bheekhampur Gate	1963	28
61	Mohammad Habib Hall	1969	20

62	Sir Syed Ross Masood Hall	1969	23
63	Department of Business Administration	1978	10
64	Department of Geography	1979	10
65	Department of Statistics	1979	4
66	Department of Electrical Engineering	1970s	6
67	C- Type Quarters Medical Colony	1988	9
68	Electronics Engineering Department	1988	8
69	Bhamhola F-Type Quarters	1989	4
70	Indira Gandhi Hall	1992	9
71	Sherwani Hall	1994	10
72	Dental College	1997	8
73	Architecture Section University Polytechnic	2006	8
74	Auditorium JNMC	2007	7
75	AMU Canteen	2010	6
76	Urdu Academy	2012	9
78	International Training Centre	2013	7
79	Library and Information Science	2014	9

The result of this table shows that the buildings which were constructed at Aligarh Muslim University from 1870 till 1970 were having a sufficient no of variable (between 22-35) in them but the buildings which were constructed after 1970 till date are having insufficient no of variable (between 3-10). This depletion in the number of variables is threatening the Heritage Character of Aligarh Muslim University.

5.   RECOMMENDATIONS

The analysis of variables tested in the seventy nine buildings at Aligarh Muslim University campus shows that there are three categories in which the variables can be assessed:
1. Variable which was neither found in abundance before 1970 and nor found after 1970.
2. Variable which was there in buildings before 1970 and is still retained after 1970 till date.
3. Variable which was there in buildings before 1970 but not present in buildings after 1970.

1. Variable which was neither found in abundance before 1970 and nor found after 1970
The three variables namely Domes, Minarets and Paintings & Sculptures were not found commonly in the buildings of Aligarh Muslim University before and after 1970 since these variables are associated to cultural and religious aspects.
The domes and minarets are commonly found in Mosques and tombs in Islamic architecture and they are there in Jama Masjid and few other mosques at the campus but are not there as regular feature in the academic or administrative buildings of the campus. Paintings & Sculptures are prohibited in Islam therefore this variables are not commonly found in the buildings of the campus though some paintings of the founder (Sir Syed Ahmad Khan) and other dignitaries are present in the academic and institutional buildings.

Recommendations
Aligarh Style of Architecture is inspired by Mughal architecture. Domes and Minarets are the basic elements of Mughal Architecture and are extensively used in their buildings therefore these elements will be incorporated in the future construction in modern design and materials to provide aesthetics and grand scale to the upcoming buildings of the campus.

2. Variable which was there in buildings before 1970 and is still retained after 1970
The variables like Boundary Wall, High Plinth, Landscaping, Built open Relationship, Green Lawns, Eave Projection & Louvers and Parapet Wall were retained for more than a century in the campus of Aligarh Muslim University.

Recommendations
These are the elements which are the connecting bridge of past and present construction in the campus and are

incorporating their best to restore the 'Heritage Character' of Aligarh Muslim University. Therefore these elements will be incorporated in the future construction in the campus.

The design of Boundary Wall, Eave Projection & Louvers and Parapet Walls are to be standardized in the future construction of the campus so as to maintain the visual balance and continuity of age in the modern buildings of the campus.

It is also recommended to incorporate some elements and feature of the heritage buildings and incorporate them in modern materials and design in these variables to 'Rejuvenate the Heritage Character of Aligarh Muslim University'.

3. Variable which was there in buildings before 1970 but not present after 1970
Out of the thirty five variables which were identified significant, there are twenty six variables which were there in the buildings before 1970 but are not found in the buildings constructed after 1970 in the campus of Aligarh Muslim University.

Recommendations
The result of factor analysis of variables have identified that Arches, Cornices & Corbelling, Climate , Green Lawns and Symmetry are the most significant among the thirty five variables and are contributing 51.886% of all the variables in the building.

Out of these five variables only one variable 'Green Lawns' is retained in the buildings after 1970 in the campus. Rest of the four variables were not playing significant role in the construction of the buildings after 1970.

Therefore these four variables will also be incorporated in the future construction of the campus.

The variables identified from the above three categories are Boundary Wall, High Plinth, Landscaping, Built open Relationship, Green Lawns, Eave Projection & Louvers, Parapet Wall, Arches, Cornices & Corbelling, Climate and Symmetry. These are only eleven variables out of the thirty five significant variable identified.

FINAL RECOMMENDATIONS
Therefore it is recommended that at least twenty one variables incorporating these above variables which is 60% of the total variables identified will be incorporated in the future construction of the buildings to retain and rejuvenate the 'Heritage Character' of Aligarh Muslim University.

6. CONCLUSION
Twenty one variables out of the thirty five significant variables identified will be incorporated in the future development of buildings at Aligarh Muslim University. Out of these twenty one variables Boundary Wall, High Plinth, Landscaping, Built open Relationship, Green Lawns, Eave Projection & Louvers, Parapet Wall, Arches, Cornices & Corbelling, Climate and Symmetry must be the integral part of the future construction at the campus.

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