Climatic Responsiveness of Buildings in British Era Punjab (Amritsar and Lahore)

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Abstract

India because of its rich cultural heritage and wealth had been attracting numerous traders, pilgrims, scholars and even invaders from time to time and has borne the onslaught of Greeks, Arabs, Turks, Mughals, Portuguese, French and finally British, who ruled for about 200 years (through East India Company and the Crown) with each asserting their power through architecture. The British hailing from cold regions initially replicated the European buildings on Indian soil but soon realized that due to tropical climate these were not successful and they will have to adopt indigenous architectural elements into their buildings to make them climate responsive. This paper briefly discusses the origin of a British bungalow in India, the modified designs of which were adopted in almost all the British colonies. Furthermore the bungalow became a generic spatial format for many colonial buildings in the times to come. The veranda of a bungalow gave respite from harsh sun and rain and was a transitional space between the main functional areas of the house or other building types and outside. Courtyard planning was another indigenous tool used during the British era that very successfully made the buildings climate responsive. Use of time tested lime mortar, mud mortar and plaster in construction of buildings also helped in imparting robustness to the construction but also helped in achieving cooler interiors. These indigenous techniques and materials were being used by Mughals (and previous rulers) and Sikhs who were the predecessors of the British who successfully applied these in their new buildings. All the major architectural developments took place in Lahore because it was the capital of British Punjab and Amritsar was the nearest city (before independence), so two buildings from Lahore and three from Amritsar were studied for the above said parameters. It was found that the said buildings are highly climatic responsive and are still being used.

Keywords: British Colonial Architecture, plan configuration, bungalow, ventilation, courtyard, Bricks, Walls, Roof.

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Introduction

From amongst all the European powers that traded with India during seventeenth century, Britain had monopolised the trade route between Europe and South Asia through the East India Company. The setting up of their infrastructure in the form of forts and other commercial establishments on or near the coasts facilitated not only trading activities but also offered protection from the forces inimical to the British interests. These structures were "termed 'factories', which, as noted, were trading posts on coasts or river harbours whose role was to move goods to and from the interior hinterland"(Sengupta, 2019: 679). The monopoly of the East India Company can be gauged from the fact that "at one point of time it accounted for half of the world's trade. (Patel, 2022)

The subsequent expansionist and repressive policies (through wars, manipulated treaties and alliances with local powers) of the East India Company precipitated in 1857 rebellion, consequent to which Indian subcontinent came directly under the Crown. 'The term *Raj* referred to British rule over India from 1757 until 1947. A cabinet minister in London directed policy, and a British governor-general in India carried out the Government's orders. After 1877, this official held the title of

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Viceroy.' (Blake, 2009) The British introduced many new institutions like railways, education, health, post and telegraph etc. and they were also responsible for the rapid urbanization in the Indian sub continent because of the burgeoning British army, development of railways and increase in agricultural production (due to development of canals) which resulted in the establishment of cantonments, railway townships and canal colonies where the British had to tackle the general problems of safe drinking water, sewerage and sanitation, roads and policing. From their arrival in 1612 AD till mid eighteenth century the buildings constructed by the British had mainly built forts for the protection of their business establishments and some churches of Georgian style in England which was prevalent during eighteenth century and they dominated the initial period of the British on Indian subcontinent. The direct replicas of British style buildings on Indian soil were not able to provide much needed thermal comfort due the fact that the British were not accustomed to varied climate of Indian subcontinent. Most of the countries colonised by the British had tropical climate whereas the British were from cold regions and climatic conditions of the Indian sub continent posed a great challenge to their survival as the extreme summer temperature during summers is around 45˚C or more in some parts of the Indian sub continent. This resulted in the incorporation of indigenous architectural elements in their designs that included thick walls, verandas, cornices for shade, balconies that were part of indigenous Architecture which not only made buildings climate responsive but the British were also able to relate themselves with the local populace. Consequent to this a hybrid style of architecture emerged which was known as Indo-sarasenic style or Indo Gothic style. By the time The British conquered Punjab in 1849, after the death of Maharaja Ranjit Singh in 1839 they had very well entrenched themselves in other parts of the Indian sub continent and they had a fair idea of how to make their buildings climate responsive through the use of shaded temperature zones, use of jallies, volumetric spaces (high ceiling), deep verandahs and use of water for creating microclimatic effects.

PLAN CONFIGURATION

Bengal in fact was the place of origin of British Bungalow, the design of which was adopted (after due modifications over the period of time) not only in the Indian sub continent but in all the British colonies.

'In the seventeenth century, bangla (with various spellings) was a native term used both by Europeans and Indians to describe an Indian structure. As this was adapted and Europeanised in the eighteenth century, so also was the term: bungelow, bungelo (1711), bangallaa (1747), bungalo (1780), with the modern English spelling of 'bungalow' first recorded in 1784. After 1820, spellings other than this are rare.'(King, 1982) Spatial arrangement in a bungalow consisted of central main areas surrounded by deep verandas, with one of them serving as main entrance and facilitated adequate ventilation and protection against sun and rain. Shaded verandahs along with airy entrance porches have perfect daytime habitation potential. In fact veranda is multipurpose space used for many purposes like enjoying the rains and breezy weather during humid season, treating informal guests, interacting with nonresident servants etc.

"While colonial bungalows from the early eighteenth century retained this spatial arrangement, their core typically expanded to a three-bay matrix (3 by 3 or 3 by 4) with a main central space surrounded by smaller generic spaces – often bedrooms, living rooms or home-offices–with the veranda corners frequently closed in to form toilets or service stores" (Sengupta, 2019: 683)

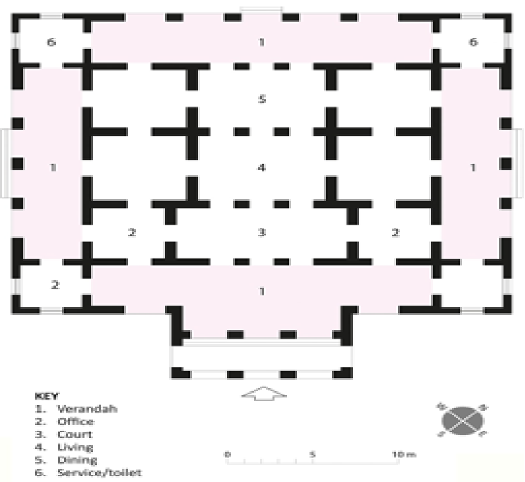


Figure 1: Drawing of the plan of the Circuit House in Bankura, India (1808).
Source: Sengupta, 2019: 683

The all-encompassing spatial configuration of bungalow had a profound effect on the design of other building types (in different parts of the Indian sub continent) since it offered great flexibility and convertibility to meet the spatial needs from time to time. "Crucially, despite its domestic origins, the bungalow became a generic spatial format for many colonial functions: houses, offices, courts, clubs, churches and other institutions." (Sengupta, 683-684) In the above said buildings, again the veranda was used as spill over area from main offices, waiting areas and for the attendants of British officers, a practise still prevalent in many of the colonial buildings that are being used even today.

ISSUE OF VENTILATION

A major point of consideration for the British was the ventilation of the building to make it habitable in hot climates of Indian subcontinent. For ensuring the cyclic air changes in a space, the air entering the room through the doors should escape from an opening in or near the roof, the Colonial era buildings had square or rectangular ventilators that were positioned in vertical alignment to the windows below to ensure stack effect for replacement of hot air with fresh air. (Islam and Muntasir, 2020: 87) Ventilators were often provided with *chhajas* to protect them from rains. The British cooled their buildings with the help of grass screens (*tatties*) that were constantly kept moist and placed in the doorways on the windward side for draft of cool air through the space, a method that was workable when a strong breeze was blowing and the wind being hot and dry. Another method of temporarily cooling the indoors is by agitating the air by fabric fan (*punkhas*) but that did not reduce the temperature. 'To secure; a thorough draft through a room, numerous doors and windows are provided and this answers well when sea breeze is blowing part of the day, or in ordinary cases when external atmosphere is tolerably cool at least at night.'(Medley, 1877: 64) This is the reason we can see large number of doors in British colonial buildings in Indian sub continent and other British colonies with tropical climate. (Figure1) Doors were generally made double, so as to occupy less space when open, they were pannelled or glazed or part pannelled and part glazed and they varied in size from 1.82m x 0.91m to 2.43m x 1.52m (6 X 3 feet to 8 X 5 feet) in the clear, and are hung on *choukuts* or door frames secured to the masonry. When more light was required, rectangular or semi-circular fan-lights were fitted over them as shown in Figure 2 and sometimes skylights were provided in the roof.

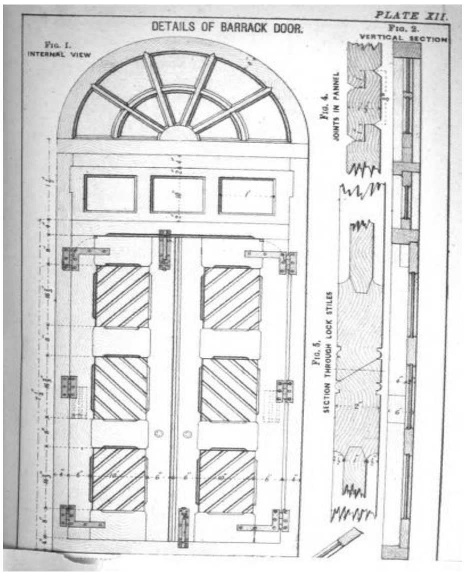
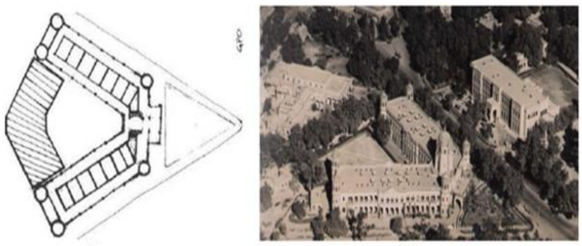


Figure2: Elevation of a typical door
Source: Medley, 1877: 64

GENERAL POST OFFICE (GPO), LAHORE (1887)

The GPO at Lahore was built to commemorate Queen Victoria's Golden Jubilee in1887 and is located at GPO Chowk on Mall Road (Shahrah-e-Quaid-e-Azam) near Anarkali and is the one of the majestic structures of British legacy. Designed by M Starmer Hack, this building was the befitting reply to mark the occasion and introduce a new institution to the natives. "It was one of the first examples of a utilitarian structure that symbolized an entirely new, western concept of building typologies for managing services such as a post office and telegraphs." (Ansari, 2015)



(a) (b)

Figure 3 (a) Schematic Plan of GPO, Lahore
Source: (Ansari, 2015) https://issuu.com/nehaansari/docs/architectural_encounters_of_the_east
(b) Aerial view of GPO, Lahore
Source: https://nl.pinterest.com/pin/475552041901964922/ on 25.08.2021 at 10:25 am

The plan form of the building compliments the shape of the site resulting from the intersection of busy Mall road and Ustad Allah Baksh road. The two wings of the building are joined to a central block with each wing being parallel to the road, thereby resulting in a quadrangular courtyard (a feature typically associated with the architecture of the Mughal Empire). Each wing of the building has a continuous row of offices running from one end to the other, having corridors on either side which is a typical characteristic of institutions in European architecture. The corridors helped in providing relief from the scorching summer sun and also regulated airflow within the rooms.

RAILWAY ADMINISTRATIVE BUILDINGS (1892-1934), LAHORE

With the advent of railways in Punjab, the British commenced connecting Lahore (capital of Punjab) not only with major Indian cities but also laid railway network within Punjab interlinking the cities of Amritsar, Multan, Peshawar, Karachi for which Lahore (because of its strategic location) was declared as Headquarter of North-Western Railways (NWR) in January 1886. The railway network within Punjab was so large that it necessitated the establishment of numerous railway workshops and required infrastructure and consequently it was declared as an independent division. Several administrative office buildings namely Finney, Bagley, Walton and Highet blocks were designed and constructed between 1892 and 1934 and collectively they were known as railway administrative complex.

Table 1. Buildings in Railway Administrative Complex, Lahore

Bagley block	1892	Col. G.O.F Bagley from 1892 to 1897
Finney block	1897	Sir Stephen Finney (K.T.C.I.E) from 1899-1907
Walton block	1926	Col. C. Walton from 1924-1932
Highet block	1934	J.C. Highet from 1932-1936

Source: Khan et al. (2013)

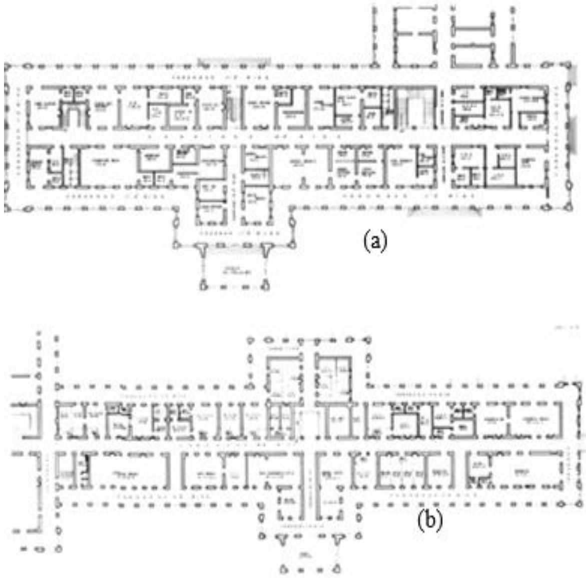


Figure 4: **(a)** Ground Floor Plan of Finney Wing (1890)
(b) Ground Floor Plan Bagley Wing (1897)
Source. Khan et al. (2013)

All the blocks were linearly planned with main offices in a row served by a central corridor and the offices were protected from harsh sun of Lahore with the help of continuous corridior on all the sides of the building. The width of verandah, corridor and offices was maintained as 11, 10 and 25 feet, respectively in Finney Wing. (Khan et al., 2013) The same linear plan configuration can be seen in Bagley Wing. The key features of British era buildings were external thick masonry (with English bricks) walls, high roofs to increase the volume to surface area ratio and ventilators near the roof to ensure adequate ventilation of the habitable spaces. Moreover the construction of critical areas was with lime or cement sand mortar and plastering with mud mortar was resorted to for cool interiors. Exposed brickwork from external side whereas lime plaster layer was made on internal side. However due to introduction of electricity around 1910 in Lahore, there was considerable reduction in veranda area and corridor width as can be seen in Walton block (1926) and Highet block (1934). (Khan et al., 2013)

ALEXANDRA SCHOOL AMRITSAR (1878)

This school was founded by the Church Missionary Society, London in 1878, so that the girls of Punjab could receive the highest and the best education. This double storeyed school building is situated on 18 acres of land and has symmetrical plan, oriented in North-South direction with main entrance to the building facing North. The rectangular plan has size 4.69M x 27.4Mis bound by four towers on each corner. The overall height of the school is 12.82M while the towers at the four corners are 17.04Mhigh. One of the towers on the front encloses a spiral staircase while rest of the towers has small rooms acting as storage spaces. Longer sides are flanked by 3.04 m wide and 5.18 m high verandahs while the central corridor is 2.43M wide. The southern side (main entrance) of the building has 21.33 M long arcaded porch which is only single storey high.

This school building has strong symmetry in the facade which is achieved through the placement of doors, windows, arches and other elements on both sides of central axis and it is placed on the site with massive volumetric subtraction in the central part (single storeyed) which forms the 7.62M high main entrance hall whose roof acts as terrace for the first floor. The double storeyed facade is punctuated by a series of three centered arches on ground floor and horse shoe arch with a lancet arch on the first floor, and the towers at the corners have different types of windows of flat, round trefoil and three centered arches have been provided at different levels. Overhanging brick dentil (figure 10) cornice can be seen below the sloping parapet of each tower as well as in the rest of the building.

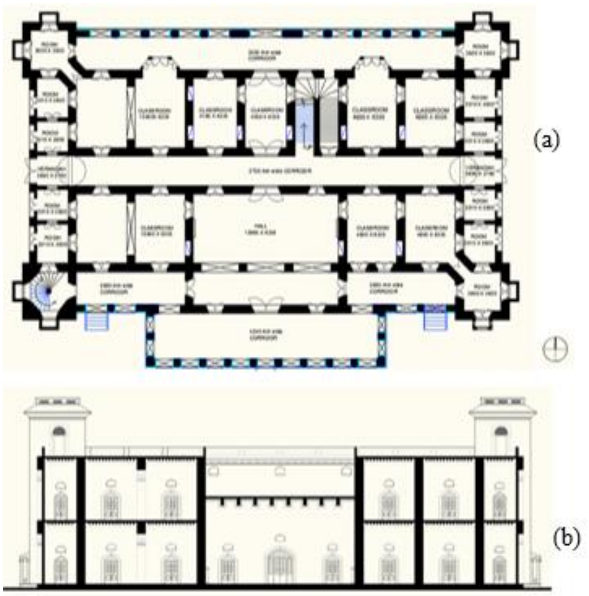


Figure 5: (a) Ground Floor Plan
(b) Longitudinal Section
Source: Building Documentation study, IV Year (2009-2014 batch), Department of Architecture, Guru Nanak Dev University, Amritsar, India

Figure 9: (a) Front View of Alexendra School
(b) Brick masonry in lime mortar and Plastering with mud mortar (mud with rice husk)
Source: Alexendra School, Amritsar, India

BKE AND I GIRLS SCHOOL AMRITSAR (1927)

As compared to Alexendra School, this school is on a small plot of land in the walled city and is approachable through narrow lanes. The length of the school building is 51.20M and the front facade and rear facades being 23.67M and 20.42M respectively. The overall height of the building is 17.75M. The classrooms have been arranged around a courtyard (9.20M x 16.38M) which is approached from a narrow entrance from the street. This courtyard leads to a smaller courtyard (6.17M x 9.22M) through double storey arched bridge connecting upper level classrooms on both sides of smaller courtyard. Despite the fact that the school is located on a small plot but the dexterity with which the classrooms have been arranged around the courtyard, ensure sufficient natural light and ventilation in classrooms at different levels of this four storeyed building. 'Courtyards fit into a specific type of architectural space, known as 'Transitional space.' Transitional spaces can be defined as the 'in-between' architectural spaces where the micro climatic condition of indoor and outdoor climate is moderated without using active strategies.' (Gupta and Joshi, 2021) Semi-open areas like balconies and passages block heat while allowing light and air to filter in. Exterior surfaces of the building are painted in light colors that reflect light thereby minimizing the heat gain. The success of the design and construction of this building can be gauged from the fact that this building is being used for the same purpose for which it was originally intended.

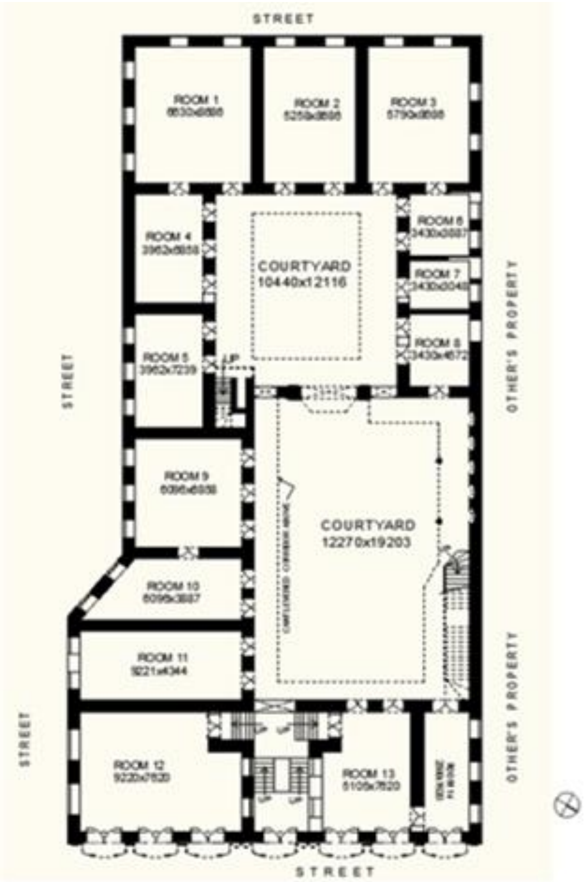


Figure10: Street Level Plan
Source: Building Documentation study, IV Year (2018-2023 batch), Department of Architecture, Guru Nanak Dev University, Amritsar, India

(a) (b)

Figure 12. (a) Front facade (deep recessed windows shaded with balconies) **(b)** Internal courtyard
Source: BKE & I School, Amritsar

GANDHI ASHRAM BUILDING (1890)

Formerly a residence of rich cloth merchant who decided to move out of the walled city, this building was constructed in the last decade of nineteenth century and the design is based on typical British bungalow (Figure 13). This highly ornate residential building with symmetrical plan has 3m deep verandas in the front and rear. The setting of the building on a large plot of land (typical feature of a British bungalow) having front setback of 28.3m and rear setback being 7.01m with its main entrance being on the southern side and offset on all the four sides ensures sufficient air movement around the building and a large number of doors and ventilators provide adequate ventilation. The 2.5 brick thick walls constructed in lime mortar and finished in lime plaster both internally and externally. 'When used as an internal render, it improves the indoor air quality by absorbing low amounts of Carbon dioxide and regulating the indoor relative humidity for a prolonged period.' 9 Paralkar V. Damle R. 2020. FARU 2020 Journal Volume 07

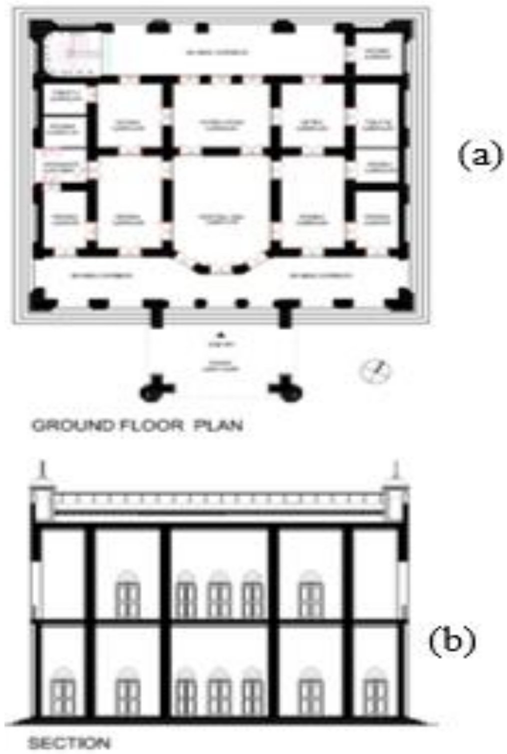


Figure 13. (a) Ground Floor Plan **(b)** Section, Gandhi Ashram, Amritsar
Source: Building Documentation study, IV Year (2009-2014 batch), Department of Architecture, Guru Nanak Dev University, Amritsar, India

(a) (b)

Figure 15. (a) Drop curtains in arches **(b)** doors and high ventilators in Gandhi Ashram, Amritsar
Source: Building Documentation study, IV Year (2009-2014 batch), Department of Architecture, Guru Nanak Dev University, Amritsar, India

CONCLUSIONS

It can be fairly well concluded that though the British had introduced utilitarian structures that symbolized an entirely new, western concept of building typologies, yet they had become very well aware that in order to survive in the Indian subcontinent; they will have to modify their buildings to make them climatic responsive. This was done adriotically by incorporating indigenous architectural elements and planning methodologies in the new buildings. Veranda in the bungalow is the major spatial component used to not only mitigate the effect of sun and rain but also to channelize the wind draft inside the interiors of the building through large number of specially designed doors. The same plan typology was used in other buildings (courts, office buildings, educational buildings) by elongating the veranda throughout the entire length of the buildings. Furthermore the ventilators near high roofs and increased surface to volume ratio (due to high roofs) ensured proper ventilation. The time tested indigenous method of arranging habitable rooms around the courtyard was thoroughly exploited in British era buildings especially on narrow plot of land in congested areas of the walled city. On the construction material front, the age old time tested lime mortar was used by the British for masonry work for the longevity of the buildings. Interiors of the buildings were rendered with lime plaster as well as with mud mortar which make the surfaces breathable and hence keep the temperature inside the building lower than the outside temperature. The study clearly shows that the elements and formal characteristics of the above buildings are thermally adapted to the climate of British Punjab.

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