Comparative analysis of different Architectural Built Forms and their Thermal Comfort aspects – Case Study Shimla

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ABSTRACT: There are different types of architectural built forms on the laps of Himalaya in the city of Shimla, the capital of Himachal Pradesh, India. It was started from the Scottish Baronial style in the time of British rule – when Shimla was chosen as the summer capital of India, followed by the traditional vernacular styles, coming up with the New-Tudor style and in recent times with the Modern Architectural style. However, the raw building materials used for all of these styles are stones, timbers, batten boards and glass. Extensive use of stone and wood makes the built form to be sculpted out from the hills itself to balance the settlement of the built forms with the nature making it harmless for the hills. Use of locally available materials and adopting local construction techniques are more responsive to the climate and geographic conditions. To ensure thermal comfort, glass was used as one of the important building materials. Now, different ways have been developed for using glass in new construction as well as in renovation of old buildings. The interior spaces have been modified as Solar Space, Green Houses, glass covered Atriums, etc. to increase the amount of heat gain in the interiors. New settlements came up with new techniques but covered in an envelope quite contrary to the former architectural styles which possess a treat to the uniformity of built texture of Shimla. Our main aim is to portray the comparison between the styles of built form from past to present and to analyse that how they have settled with the nature and encountered the climatic constraints of the hills depending on the primary case studies drawn into a final conclusion. This paper will emphasise that how the styles have been modified since past to present along with the natural and climatic restraints developed day by day in Shimla – its physical manifestation in architecture which has been done extensively in the past and the abrupt discontinuity in the texture in recent years putting the process of urban design in question.

KEYWORDS: Architectural Built Form, Building Envelope, Urban Surface Texture, Thermal Comfort

3 Introduction:

“I HAVE A DEEP LOVE FOR THE HILLS AND MY RELATIONSHIP WITH HIMACHAL PRADESH IS VERY SPECIAL. HERE THE NATURE IS BEAUTIFUL AND THE PEOPLE ARE PEACE- LOVING, I HAVE ALWAYS LONGED TO LIVE HERE.”

- INDIRA GANDHI
During colonial period in first half of 19th century, British declared Shimla as their Summer Capital. Shimla was popularly known as “Jewel of Orient”, “Queen of Hill Stations”, “Star of Hill Resorts” and “Town of Dreams”. The British established many architectural masterpieces such as Vice Regal Lodge, Gorton Castle, Railway Board Building, Gaiety Theatre, Town Hall, Auckland House, Barnes Court, Bungalows, Churches etc. The building facades, sloping roofs, dormers, doors, windows, entrances and chimneys of numerous types are replicated from the European buildings which leaves an ever-lasting impact on one’s mind and provide an opportunity to understand the Western saga of art and architecture. Shimla has become a multifunctional city along with the dominance of tourism, administration and institutional activities. Due to the increasing demand of land, people has started horizontal and vertical expansion to create more floor space. The Central Shimla, in the recent times has become congested and crowded and requires attention to harness its potential, on one hand and to rehabilitate the spill-over functions suitably with public participation, on the other.

4 Urban Texture – Past and Present: The presence of cedar forests has played a major role in the evolution and development of the traditional architectural forms in Shimla, the “Kathkuni” style being the most important. The British constructed their homes, bungalows, castles according to the Scottish Baronial architectural styles and in the later half with the New Tudor style, both using the blue black dressed stone masonry with slate roofs. While, teak, cedar wood and stained glasses were used to form their royal interiors and notably all these materials were available locally in Himachal Pradesh which were brought by bullock carts. Their architecture used to follow the picturesque
background of the nature, while the stones depicted the Hills, the woods depicted the nature. Modern construction techniques in recent times are more concerned towards creating habitable spaces rather than respecting the nature, the use of concrete in framed structures to hasten the construction and clearing up the forests due to rapid urbanisation has stained the past glory of Shimla. The unique surface texture of Shimla is depleting day by day due to the lack of rules and regulations of the concerned authorities. Only strict laws by the state government and authorities and awareness programme can bring change to this situation.

Figure 3 & 4: The simile between nature and the building, (Main Hostel Block, Vice-Regal Lodge)

Source: Authors

3. Thermal Comfort and Design Aspects: The general comfort conditions for the climate of Shimla can be simplified by the objectives and physical manifestation as given by:

<table>
<thead>
<tr>
<th>OBJECTIVES</th>
<th>PHYSICAL MANIFESTATION</th>
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<tbody>
<tr>
<td>1) Resist heat loss</td>
<td>Orientation and shape of building. Use of trees as wind barriers</td>
</tr>
<tr>
<td>Decrease exposed surface area</td>
<td>Roof insulation, wall insulation and double glazing</td>
</tr>
<tr>
<td>Increase thermal resistance</td>
<td>Thicker walls</td>
</tr>
<tr>
<td>Increase thermal capacity (Time lag)</td>
<td>Air locks/ Lobbies</td>
</tr>
<tr>
<td>Increase buffer spaces</td>
<td>Weather stripping</td>
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<tr>
<td>Decrease air exchange rate</td>
<td>Darker colours</td>
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<tr>
<td>Increase surface absorptivity</td>
<td></td>
</tr>
<tr>
<td>2) Promote heat gain</td>
<td>Walls and glass surfaces</td>
</tr>
<tr>
<td>Reduce shading</td>
<td>Sun spaces/ green houses/ Trombe walls etc.</td>
</tr>
<tr>
<td>Utilise heat from appliances</td>
<td></td>
</tr>
<tr>
<td>Trapping heat</td>
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Source: mnre.gov.in-solar-energy

The British generals are more used to this climatic conditions so they prioritised in resisting the heat loss by using proper orientation, dark textured stones, physical barrier using landforms and vegetation. Heat gain was achieved through double walled construction, use of glass in facades
and fireplaces in the interiors. The comfort conditions remained same over the years with people now using modern techniques to achieve the same. Since concrete and regular brick masonry has less thermal resistance as compared to the stones people has started developing passive solar heating techniques like - south facing glass & thermal mass to absorb, store and distribute heat through direct and indirect gain. Other techniques include – Trombe wall, Solar Chimney, Double glazed window, Air heating panels, Solar Water Heating and Photovoltaic systems.

4. Case Study

4.1. Primary Case Studies

4.1.1. Indian Institute of advanced studies (Vice Regal lodge), Shimla, Himachal Pradesh

The building was constructed during the Viceroyalty of Lord Dufferin during 1884-1888. Designed by the public-works department's principal architect, Henry Irwin, in a dark and heavy Elizabethan Renaissance style and located atop observatory hill at the western end of Shimla. Elements of Scottish Baronial Architecture are also visible in the building including light blue-black stone masonry with tiled pitch roofing.

The main block has three storeys and the kitchen wing has five. The building is situated in the lap of evergreen coniferous forests all around in its environment, which provides a distinct ambience and reduces heat loss. The thermal resistance of the building materials is high enough to reduce heat loss though it also takes a considerable time to gain heat.

Figure 5&6: Sketches showing the design of the façade according to the picturesque background, and the glass atrium inside to allow maximum daylight in the interior spaces.

Maximum fenestrations are present in the eastern and western walls to increase the heat gain; the building is oriented in the east west axis to absorb maximum sunlight throughout the daytime. The darker texture of the walls is to increase the surface absorption in the building. Vice regal lodge was the lone exception of a building made entirely of stone and slate roofing perhaps to set it apart for its importance.

Exterior walls are double layered, while exterior façade is made completely with stone masonry, the interior has a separate cavity with woodwork. To keep the interiors, warm several fireplaces are laid out
with service outlets from the rear side of the building merged with buttresses. The skylights in the roof portion which houses an atrium traps the heat and creates stack effect for heat gain and also well illuminates the central atrium throughout the daytime. Though the interiors and the front façade are maintained and conserved thoroughly the rear façade is in a dismal state and also needs to be conserved to treat the majestic building envelope as one. Currently the building is known as Rashtrapati Niwas, and houses a museum, library and research facility for scholars.

*Figure 7 & 8: Pictures showing the front façade of the Více Regal lodge*  
*Source: Authors*

### 4.1.2 General Post Office, Shimla, Himachal Pradesh

Taking a Traditional example of Vernacular Architecture of Shimla, General Post Office, The Ridge, Shimla is perhaps the most beautiful example. The old three storied GPO building built with local timber and stone in old English hill architectural style is a model of Wild West Gothic structural design.

*Figure 9 & 10: Picture showing the G.P.O in the Mall Road, Shimla*  
*Source: Authors*
The building was renovated for the first time in 1972 when a massive fire broke out in the ground floor destroying many heritage records. It was again given a facelift in 1992 when the building was declared as one of the few heritage post offices in the country. The traditional outer appearance was changed in 2009 and the post office was modernized with top end facilities under the venture Project Arrow.

In 2010, the old timers of Shimla had strongly objected with the Department of Posts, when the age old color scheme of Shimla GPO was changed to the universal red and white format adopted by the department in a central government decision lately. All post offices in the summer capital of Raj are painted in red and white much to the displeasure of environment activists and old residents.

Conventional Dhajji construction, the building constructed in 1880 is a nice example of English hill Architecture. The building overlooking the ridge is oriented towards the street in east west axis with maximum number of fenestrations to gain sufficient light and heat. Rooftop chimneys were designed in the central atrium to circulate heat from the combustion throughout the whole building. It was after the fire broke out that the chimneys were no longer functional. Corrugated galvanised iron sheets (C.G.I) are used in the rooftop for considerable heat gain.

4.2 Secondary Case Study

4.2.1 Himurja Building, Shimla, Himachal Pradesh

This is a fine example of a retrofit building based on the concept – “Limitations turned into Opportunities”. The existing building was a simple structure with no adaptations to local climate. This building is taken by the Government of Himachal Pradesh under Himachal Pradesh Government Development Agency as an experimentation project where the building with passive climatic techniques are retrofitted into the old building.

![Figure 11 & 12: Pictures showing the building before and after remodelling](source: Arvind Krishnan, www.slideshare.net/arvindkrishan/project-himurja-office-building-shimla)
Daylight and heating is achieved through the air heating panels designed as an integral part of the south wall to provide effective heat gain. Distribution of heat gain in the building is through a connective loop that utilizes the stairwell as means of distributing heated air. Double-glazed windows with proper sealing to done to minimize infiltration. Insulated R.C.C diaphragm walls on the northern side are constructed to prevent heat loss.

Other passive climatic features include the solar chimney, specially designed solarium on southern side for heat gain. Integration of windows and light shelves ensures effective daylight distribution. Solar water heating system and solar photovoltaic system are also integrated into the building.

5. Passive Design Techniques

Considering the section of Himurja Building, we can find several techniques which have been used to climatically modify the buildings thermal comfort aspects.

5.1 Solar Chimney

The Solar chimney is one of the most important concept which uses the sun’s heat to provide cooling using the stack effect.

![Solar Chimney Diagram](source)

*Figure 13: Section demonstrating various passive solar features integrated into the building envelope*

*Source: Google images*
5.2 Trombe wall

A thermal storage wall is defined as a south-facing wall that is glazed on the outside. Solar heat strikes the glazing and is absorbed into the wall, which conducts the heat into the room over time. The walls are at least 8 inches thick. Generally, the thicker the wall, the less the indoor temperature fluctuates.

![Trombe wall section](image)

*Figure 14: Trombe wall section showing the concept of thermal comfort*

**Source:** Google images

5.3 Air-Heating Panels

This is similar to the Trombe wall, it has Photovoltaic panels instead of glass which traps heat and reduces the heat loss from roof. Loop of hot air is created through staircase hall and solar chimney for passive heating.

![Air Heating Panels](image)

*Figure 15: Typical section of air heating panels with air gap in between*

**Source:** Google images
5.4 Insulation and Double-Glazed Window

Good insulation of 5cm thick Glasswool/Rockwool and minimum fenestration (only in toilets) on Northern exposure prevents heat loss. Infiltration losses are minimized through weather-proofed (with no Thermal bridges) hard plastic windows. Double glazing heat loss from glazing without creating any internal condensation.

5.5 Sunspace / Sunroom

A sunroom may be a room in a building specifically tailored to that function with many windows and appropriate climate control, a connected structure erected during new construction, or one added some time afterwards. Attached sunrooms are typically constructed of transparent tempered glazing atop a brick or wood "knee wall", or framed entirely of wood, aluminium, or P.V.C and glazed on all sides. For privacy, frosted glass or Breeze block is used.
Some sunrooms are designed to exploit a scenic view, others to collect sunlight for warmth and light. These, composed entirely of framed glass and usually called Solariums, are typically found in high latitude (low sun angle) or cold (high altitude) locations.

6. Discussions
Comparing the built forms of Shimla, we find that there are mainly three approaches like:

i. First the old buildings of historical importance which are carefully restored or under restoration,

ii. Second, the old buildings which are abandoned and rebuilt with modern typology

iii. and Third, the new buildings with poor domain of architecture.

Delving a bit deeper, we can find that the biggest hotels in the town too have British buildings. The Oberoi Clarks, Wild Flower Hall, Cecil, Wood Ville Palace, all have an Imperial past. Some extensive renovation has gone into maintaining them, but at the core, they still adorn the British zeal. Even among schools and colleges, some of the best convents like St. Bede’s College, Tara Hall, Bishop Cotton School, and Auckland House School, all are known for their well-kept environments. While many old office buildings had to be replaced with new ones like the Vidhan Sabha of Shimla due to unforeseen circumstances, others are still housed in British buildings. A major part of the Secretariat still works from the old building (Ellerslie). From the calculations and data there is enough evidence that the old buildings of Shimla are not only aesthetically blessed but also climatically best suited, even after two hundred years.

Figure 20: Grace of the old buildings and the poor architecture of the new
Source: Picture Courtesy: Pratima Kalra, Shimla losing its British Legacy- newspaper article – H.P hill post
The new buildings should be constructed following the principles of the old local techniques which will not only reduce cost but also will enhance the urban texture of the city. Some of the abandoned buildings can be remodeled to fit functions as required by the urban domain. Basically, the remodeling can be done keeping and preserving the building envelope to safeguard the heritage and texture, this will reduce the construction costs significantly and will also lessen the embodied energy.

While the state government is doing the best by carefully conserving the Gaiety Theatre spending a whopping 122 crores, they should also take care of the urban slums which are sprouting day by day. Many shanties and slums have grown around the majestic buildings and care should be taken to properly rehabilitate the urban slums with low cost construction techniques so that it uniformly merges with the texture of the city. The Lower Bazaar area were meant for the poor people but due to the population explosion and unplanned growth of habitable spaces, it became a clumsy street with no distinct character. Proper land distribution and survey can chalk out the problem and can restrict the urban slums spawning into the main city centre.

**Figure 21:** Shanties and urban slums had grown near the majestic buildings.

*Picture Courtesy: Pratima Kalra, Shimla losing its British Legacy - newspaper article – H.P hill post*

**Conclusion**

The scope of this research is to compare the recent built forms of Shimla with the older ones and to produce climatic efficient buildings to save the natural resources. The modern techniques of passive design are very promising and energy-efficient and they can be incorporated into the old buildings. Keeping the building envelope intact the changes can be made in the interiors or in the exteriors also without endangering the old facades, this will not only keep the urban surface texture homogeneous but also will trigger a negative carbon footprint and lessen the amount of
embodied energy drastically. A careful look into the colonial impulse behind segregating spaces and its repercussions clearly suggests that Shimla was never entirely a ‘City of Dreams’, but it is interesting that in today too, amidst the squalor and haphazard developments, may tourists, residents, and writers continue to associate the idea of Shimla with such romantic evocations. This may be because of the English romantic fantasy of the Shimla’s built heritage that still survives with respect in the visitor’s mind. It’s high time to preserve the "Queen of Hill Stations", Shimla to respect the people’s emotion attached with one of the most Beautiful Hillstations of India.

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