Transformation in Traditional Havelis: A case of walled city Jaipur, Rajasthan

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Abstract—The dwellings of past, which provides us a rich fabric of experiences, bear witness to such efforts, one may feel a sense of wonder while looking at these Havelis and finding elements in similar climates, which have been discovered as a result of the human efforts to control the environment for maximum comfort. Traditional buildings are the reflection of the life style of the local people. These buildings have a great impact of the period in which they were constructed. Similar climates result in similar house forms. This article is about traditional buildings of Rajasthan, viz; Gadh, Mahal, Baag, and havelis. The article discusses the features of these building and detailed study is done for traditional residence havelis supported with case study of a havelis in walled city Jaipur. The architectural built form of these havelis has evolved in response to the climate, lifestyle and availability of material. These havelis are excellent examples of sustainability in the hot and dry climate of Rajasthan. The havelis of Rajasthan used courtyards and other related elements as the perfect architectural response to Rajasthan’s diverse culture and climate. But at present due to population pressure, increasing commercial activities and changing lifestyle of people lot of transformation is taking place. As a result of that, load on energy and infrastructure is increasing and creating lots of social and environmental issues. Also due to lack of maintenance, buildings are in dilapidated state and heritage is being lost. This article emphasizes on the need of sustainable & energy efficient development of cities along with Heritage conservation of our traditional buildings.

Keywords - Havelis, Heritage, transformation, Energy Efficiency, Sustainable development, courtyard, dilapidated

I. INTRODUCTION

Rajasthan is situated in the western region of India and its land is more varied than any other region. It has a diversity of geophysical features, which add to the richness and variety of its cultural expressions. It has the Aravalli range of mountains, fertile plains, deep wild glens, forested valleys, lakes, wild life sanctuaries, and the desert sand dunes of burning heat and freezing cold. Lying in the northwest of India, the boundaries of Rajasthan, touch Pakistan and Punjab and its history dates back to ancient times. Kalibangan, an Indus civilization site in northern Bikaner, was an important walled city of the Harappan period. Above all, Rajasthan is the cradle of distinctive Rajput culture and traditions. Rajasthan has a rich and colorful history, which makes it a very famous state. This article discusses various traditional buildings of Rajasthan used for residential purposes. The habitation of past, provides us a rich experience, which observes the different elements of these buildings which have been discovered as a result of the human efforts to control the environmental comfort. Traditional buildings are the reflection of the life style of the local people. These buildings have a great impact of the period in which they were constructed. Similar climates result in similar house forms, for example in Jaipur, Jodhpur, and Jaisalmer dwellings, one would find courtyards, terraces, otalas and balconies or chhajjas. Such elements have evolved from the human efforts to fulfill the needs mentioned above. These elements gradually were adapted to other functions than these for which they were originally intended and new meaning for them was found. Rajasthan architecture is a perfect mixture of Hindu and Mughal structural pattern.

II. TRADITIONAL RESIDENCES OF RAJASTHAN

In Rajasthan, there are mainly four types of Traditional Residential Buildings:
- GADH or FORT -: palace built on highest level or top of the hill.
- MAHAL OR PALACE -: palace built on ground level
- BAAG or GARDEN -: a place full of gardens for recreation purposes
- HAVELI: traditional houses for employees or public
The Forts or Gadh on hills of Rajasthan, exhibit an important interchange of Princely Rajputs philosophies in fort planning with art and architecture from the early to late medieval period, and the varied physiographic and cultural zones of state. Rajputs architecture is diverse sharing common ground with Mughal architecture and it draws inspiration from antecedents and neighbors, having influence on later regional styles. The example of forts in Rajasthan are Amber fort, Nahargarh, Jaigarh fort in Jaipur, Mehrangarh in Jodhpur, Junagadh in Bikaner and Jaisalmer & Bharatpur fort etc.

A. GADH or FORT

The fort or Gadh is built on highest level or top of the hill. It is enclosed all around with defensive walls covering around 20 kilometers length in perimeter. It bears testimony to the power of the Rajputs princely states that flourished in the region from the eighth to the 18th centuries (UNESCO). Major urban centers, palaces, trading centers and other buildings including temples were enclosed within defensive walls. The forts also use the natural defenses in the form of hills, deserts, rivers, and dense forests. A traditional fort also includes extensive water harvesting structures, for fulfilling water needs of city in such a water scarce area.

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B. Mahal or Palace

Similar to forts, palace also shows the beautiful architecture of the royal Rajput fortified palaces, with huge gates for entry. The difference with the fort is that palaces are built on ground level and these are the private residence for royal families. viz; City palace, Rambagh palace Jaipur, Umaid Bhavan palace Jodhpur, Udai vilas palace dungarpur, City palace & Lake palace Udaipur, and Lalgarh palace Bikaner etc.

The Palaces and havelis of Rajasthan signify the true historical essence and heritage. Few palaces in Rajasthan are still being used as residence to royal families. The architecture of the palaces in Rajasthan is a very ethnic mix of Mughal and Rajputs architecture. Some of the palaces like lalgarh palace Bikaner, city palace Jaipur etc., were built with extensive fortifications to protect against enemy attacks. These palaces have integrated development as along with separate residences for women and men, these also have provision for private gardens, fountains, public courts, temples etc. Most of the palaces are now converted to heritage hotels or museums.

C. BAAG

It is a place, full of gardens for recreation purposes. For example Sisodiya Rani ka baag & Ramniwas baag Jaipur, Mandor Udyan Jodhpur, Rani Padmini Garden Chittorgarh, Sahelion Ki Bara Udaipur etc. In Rajasthan there are varied areas, there are beautiful green gardens constructed by the previous rulers of Rajasthan to contrast the harsh terrain and climate of the land on the other hand. Anyone who takes a stroll in these beautiful lush gardens is sure to put the heat of the desert into oblivion. Let us begin our walk into the best five gardens of Rajasthan. The general impression of Rajasthan is that of parched desert land and the sight of such lovely green gardens with blooming flowers spreading out delightful fragrance and cool breeze giving a sensation of calmness is no less than surprising and gives a feeling of it being a mirage. They display how human has won over the unpleasant part of nature. These baag used to have a building complex, water bodies, fountains, garden areas and other ornate & landscape features.

D. HAVELI

This traditional courtyard house known as Haveli is a large family residence for employees and public, its size and aesthetics depended on the status of family. It is airy and equipped, built around one or more courtyards. The size of openings on outer face of buildings are small to cut out harsh sun and hot winds, also it helps to enhance the privacy. Narrow flights of steps led to upper floors. Cusped arch, foliated columns and vegetal motifs decorated the facades. Havelis were built in medieval times for a very conservative society's needs. Hence, the introvert character reflected in the plan there are no exterior window except in front façade. One courtyard was commonly shared by male members and outsiders and other was exclusively for females due to introvert social conditions. Famous examples are dhabaiji ki havelis, munshi ji ki havelis, samode Jaipur, and Patwa havelis Jaisalmer etc.

The beautifully decorated havelis, painted in bright colors and complex built depict the royal magnificence of Rajput kings. The architectural style prior to the foundation of Jaipur city was indo-
sarcenic with greater influence of Hindu style. The impact of Mughal style was felt more from 1700 onwards. The bagalda roof of Bengal style is extensively found in Rajasthan due to migration of artisans from Delhi to Jaipur. The Hindu temples had typical fluted Hindu shikhara over sanctum and octagonal sloping roof over mandap; the temples were constructed in trebated style. The Jain temple had the bell shaped domes over sanctum and octagonal sloping roof over mandap but here also sarcenic or Mughal influence is felt in cusped arches. A few havelis are converted into heritage hotels in also. The architecture, built form and energy efficiency of havelis will be discussed in further sections.

Out of these four types of residential building, first three types Gadh, Mahal & Baag are many times get protection via heritage conservation and other methods. sometimes they are converted in to museums and sometimes used as commercial purposes such as in hotels but havelis comes under general uses, these comes exclusive under private ownership and people transform these havelis according to their need, without any consideration for heritage conservation and protection. In this article detail Architecture and Planning of a typical havelis in Rajasthan is discussed and further exclusive case study is done on havelis of walled city Jaipur, showing transformation in the havelis with its causes and consequences.

### III. THE TRADITIONAL HOUSE (HAVELI)

Haveli is defined as the large traditional Indian house having one or more courtyards. The main elements/components of the Haveli are:

|---------------|------------|-----------|---------------------|------------------------|---------|

**A. COURTYARD**

It is commonly called as “CHOWK”. It is a centrally located open place surrounded by partly shaded places and/or fully shed places. It Works chiefly as a source of sunlight and air for the activities occurring in the adjacent areas. A courtyard serves many purposes like centre for various rituals & household activities, worship of tulsi plant. Activities found to be occupying thus place are cleaning the utensils, washing or drying the laundry, taking water from the tap, and at time children playing; during the afternoons, the place is found to be empty or else occupied with the “work” activities. The place gets hot in the afternoon hours. The traditional Indian courtyard is built on the principles of Vastu Shastra, in which all spaces emerge from central courtyard of house with all other activities revolving around radiating through the entire house. Some havelis have multiple courtyards, separate for men and women to provide them with privacy. The courtyard also served as a microclimate modifier.

**B. PARSAL (TIBARA)**

It is a partly shaded place surrounded on one side by the open place (courtyard) and on the other side by the fully shaded place Choubara/ Khadki. This place is Shaded with low intensity of Light. It has both “active” and “passive” activities and works as a “transitory” place and this is why it is the most “active” element of the dwelling (located between the fully shaded rooms and the open courtyard it receive the light from the courtyard and takes it to the room. Places of shade and shelter function as social meeting places and shaded sitting places outdoor places.

**B. OSARI**

It is very similar to the ‘Parsal’. However, parsal has wall on three sides and osari on four sides. A partly shaded place boarded on one side by the courtyard and on the other side by an open or shaded place.

**C. Khadki (Choubara)**

It is a fully shaded place or rooms with Osari (a partly shade place) on one side, and either an open, or partly shaded place (Otala), on the other side. It is a supplementary to the Osari. This enclosed, fully shaded place works as a filter to street heat, light and noise. Activities occur are ‘rest’, ‘play’, ‘site’ and at times ‘dry’. Cooler and darker than other elements studied owing to its location (sun’s rays never enter). Its small dimensions do not allow it to become an entrance chamber.

**D. Zarokha/Verendah**

It is a projected place for, shade, sun, light, and breeze. A partly shaded or open place However, Verandah is Located on the ground floor, and Jharokha on the upper floors. Jharokha is meant to shade the lower storey and exposed to the street for communication.
also works as a shelter from the rains for the rooms next to it and the lower storied rooms.

E. Otala (OR Otta)

It is the outer most place of a dwelling. Either an open or a partly shaded place. At outdoor place attached to each dwelling, raised from the steer level and usually sheltered from above by a verandah or rooms projecting over Otala. Works as a meeting place and a ‘play’ place for an individual family or a few neighboring families particularly during the winter afternoon and summer evenings.

Figure 3 External view of a traditional house

Figure 4 Internal views of a traditional house

Other prominent Characteristics of typical havelis are; Plinth of house and the main entrance is generally kept high at some places. The Door Height is very less to control entry. Each door in the house is beautifully crafted. In staircase, the height of the risers is high while width is very small. Brackets are used to support the roof while Niches in the wall with the recesses is used to keep oil lamps. Use of stone slabs to built the “parinda” for drinking water storage. Rainwater outlet is given at roof. Wooden false ceiling used in old houses. In old houses, the terrace is mainly used in summers to sleep at night. Every house used to have a manual flour-grinding machine (Atta Chakki).

Figure 5 Essential Functional elements of a traditional house in Rajasthan

Figure 6 Essential Structural elements is a traditional house in Rajasthan

Figure 7 Other internal elements in a house

IV. ENERGY EFFICIENCY OF TRADITIONAL HAVELIS

Historic buildings are naturally sustainable. Our traditional architecture had an immense knowledge of passive techniques, and there were no problems related to the energy crisis. While planning the traditional settlements and buildings, extreme climatic consideration was given to the use and of open spaces, water bodies, construction material, built form and treatment of facades of buildings. Residences were designed to mitigate the worst excesses of the hot and dry climate, with a range of spaces for use at different times of day and in different seasons; .The open spaces are quite significant in the social lifestyle of the people forming the meeting spaces and are centre of activities during the different times of the day. The water bodies thus became coherent with the open spaces and the much required lung spaces for the city contributing in keeping the climate cool, and acting as a node for their social and cultural activities.

Built form: The typical house design of Jaipur is compatible to the climatic conditions as well as social conditions. The built form is very compact in its structure and suited to the hot dry climatic conditions. The houses or Havelis have an introvert plan around a courtyard. The treatment of the facades and openings indicates a sensitive response to climatic conditions.
The closer-knit structures help to reduce exposed surface area of building to harsh sun and therefore heat gain of a building is reduced. The spaces between building form narrow lanes, which protect the pedestrians for most of the day from sun.

**Walls and roof:** The walls and roofs are having good thermal resistance to protect from hot climate. The size of openings on outer face of buildings are small to cut out harsh sun and hot winds, also it helps to enhance the privacy.

**Openings:** An important feature of the buildings in these walled cities is their porosity; a haveli is full of openings. These openings are different in size, from series of windows and shafts to finely carved stone Jalis, and all this allows passage for through cross ventilation. Windows are plentiful in series but unglazed to allow efficient ventilation and closed by wooden panel/shutters. The cross ventilation is created by minimizing the area of building surface exposed to sun. A good portion is covered by a protective outer layer such as an overhang, a projecting balcony, a window with an arched recess, or a carved stone Jali.

**Courtyards:** With compact organization, the house and the streets becomes very close to each other, so the most natural thing was to close the house to the exterior and open it to the interior thus making the courtyard an extremely important feature of the house. A courtyard is a very important element of these havelis for thermal insulation. When only a single wall receives the heat of the sun's rays, the immediate environment inside the house and the entire house gets heated up. However, if the immediate environment is a secondary space, like courtyard or gap between an overhang and the wall, with air flowing through it, then the heat that enters the secondary space will dissipate in the street before it finds its way into the house. The courtyard not only provides better shelter for hot and dry climate but also acts as a common space around which rooms are planned. Generally, the courtyards are of small size to contain cool air and to avoid harsh sun. In case of larger structures, the numbers of small courtyards are more rather than having one or two large courtyards. Other spaces like parsal, tibara & choubara adjoining courtyard adds to comfort.

**Jharokha/ Recess and overhangs**
The numerous recesses and overhangs of the building’s facade have a further purpose, to draw cool air into the building. Since the streets of traditional cities spends most of the day in shade because of tall buildings on either side, the air that passes through the facade from the street is much cooler than the air exposed to the sun.

The cool air enters through the havelis front facade, circulates through the rooms and then escapes through one of the courtyards taking out the hot air along with it. At one place, courtyards are the largest open space in a haveli, and then on the other end of the scale are the intricately carved stone jails as smallest openings. **Jharokha** is a projected place for, shade, sun, and light, breeze located on the upper floors. The partly shaded or open place (meant to shade the lower storey) owing to its small width (no verandah was found more than three feet wide) it does not shade the lower.

**Jalis:** The advantage of a Jali is that it blocks the direct rays of the sun and yet permits air to enter the room and is designed to grant privacy. The balconies of two houses on opposite sides of the street in old cities are often extended so far that people could almost reach out and shake hands. With the stone Jalis carved at an angle of forty-five degrees sloping down, the viewer can maintain his privacy while looking down at the street.

**Building Materials & Construction Techniques:**
Each community produces its own architectural forms and techniques, evolved to meet the challenges of a unique set of conditions. The climate is a primary influence on architectural forms, not only in the challenges, it poses to the builder but also in the materials, it supports. Both timber and mineral hardpans are the major building resources. These material are Mud, Adobes or Sun Dried Bricks, Clay tiles, Terracotta, Stone, wood, Rubble Masonry, Lime & Lime Mortar

Almost all the traditional buildings in Rajasthan are constructed in different types of sand stone depending on local availability. Sand stone is a good insulator and a poor conductor. It reflects most of the sunlight heats up slowly and allows little of that heat to pass through. During the day, the outer layer of stone gets heated and the heat is radiated to the immediate environment. At night, when the temperature drops the stone radiates the heat stored during the day. Also in these havelis, a system of modular construction is used, in which cutting the sand stone into standardized columns, beams, wall panels and floor slabs that could be arranged in endless permutation and combinations to give each haveli both a unique character and kinship with its neighbors.

**V. TRANSFORMATION IN HAPELIS**
In many places, the original haveli owners moved out and others moved in, and the havelis succumbed to the twin insatiable pressures of a growing population and commercialization. In a typical story of haveli decline, the joint family splits up and sub divides the haveli. Parts of the family set up commercial businesses, bringing strangers into the once-private core. Sections may be rented out or sold to people with little interest in the haveli. With no overall maintenance, communal areas quickly decay, and there is little incentive for the maintenance of individual parts; and with no overall control, there is nothing to stop piecemeal and inappropriate
alterations or encroachments on communal spaces. Eventually the haveli becomes just another part of the bazaar. Others become godowns or slum housing, or are simply knocked down and redeveloped. The unconsidered appreciation of some of the haveli’s decorative details has adds a further threat, as houses are robbed of their traditional doors and shutters, leaving them more vulnerable to the weather and other threats.

The basic factor is to apply the principles of construction, which have existed from times immemorial to the present innovations in techniques, materials and scientific products for better solutions.

Hence, Courtyard planning with big windows, low sills and high ceiling is provided to support ventilation and increase comfort levels as this area is having hot and dry climate with moderate rainfall.

VI. CASE STUDY- HAVELIS IN WALLED CITY JAIPUR

The houses in the walled city are mostly built 100 to 150 years back. These are planned in typical Rajasthani architecture. The bazaars, traditions, crafts and products, culture and value systems have also been reflected in the build form existing in the walled city. Here houses are mostly two-storied with decorated doors, windows and balconies with graceful balustrades or perforated screens. There are mainly three types of residential area in the walled city

High Class Residential Areas: Inhabited by jewelers, businesspersons.
- Mostly old, spacious multistoried, known as havelis with many courts;
- Inner courtyards cover 50% of the total plinth area of the houses;
- Infrastructure facilities in such neighborhoods are adequate.

Middle-class residential Areas: occupied by small traders, servicemen, restaurant
- Houses in these areas are old, untransformed, three-storied structures.
- Typical small inner courtyards covering 25% of the total plinth area leave the rooms on the ground floor.
- Houses not properly ventilated.
- Toilets and bathing facilities are usually available only on ground floors.

Low- class residential Areas: occupied by artisans and labourers.
- Houses are usually single or two room tenements, mostly semi-pucca.
- Houses are over crowded with no open spaces outside the buildings.
- Very few houses have electricity connection, toilets or bathrooms.

For detail study of Haveli, two havelis selected to study the traditional architecture, transformation in havelis and its impact.

A. Haveli-1

This Haveli is located in Chowkry Modi khana on lal ji saand ka Rasta having area of about 800sqm occupied by Brahmans. This was initially single stories with 2-3 rooms on first floor planned in typical courtyard pattern; Courtyard is used for light and ventilation.

Activity Spaces
This Haveli belonged to Brahmans working as pundits in the temple which is adjacent to it. The Haveli has a symmetrical plan with a single square shaped courtyard. Entrance is located on the east. Male and female areas were separate but no purdah system. Haveli had a direct entry to courtyard as it was more open to public sharing a similar status of the temple. In this Haveli transformation started by opening shops at road side ground floor and then gradually complete ground floor is commercialized and further also subdivision of house. Inner rooms are used for storage purpose due to increasing need of commercialization. Part of first and second floor is also being used for storage.

Figure 8 Haveli Plan and transformation

<table>
<thead>
<tr>
<th>TRANSFORMATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground floor totally being used for shops and commercial storage. Courtyard used for parking, storing scrap &amp; other household activities also for &amp; other unusable things. Structure is of pucca material but it is not maintained. Some traditional room that is vacant &amp; dilapidated, as the owner has shifted to outer areas without taking care of it.</td>
</tr>
</tbody>
</table>

Table 11 Transformation Profile in a Haveli

<table>
<thead>
<tr>
<th>Transformation</th>
<th>STAGE-1</th>
<th>STAGE-2</th>
<th>STAGE-3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typology</td>
<td>Dwelling</td>
<td>Cluster</td>
<td>Apartment</td>
</tr>
<tr>
<td>Land use</td>
<td>Residential</td>
<td>commercial</td>
<td>commercial</td>
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<tr>
<td>No. of families</td>
<td>1</td>
<td>8</td>
<td>5</td>
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<tr>
<td>Income profile</td>
<td>middle class</td>
<td>Middle class</td>
<td>rich</td>
</tr>
<tr>
<td>Literacy rate</td>
<td>Fair</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Average area under each du</td>
<td>600sqm</td>
<td>80-100sqm</td>
<td>40-50sqm</td>
</tr>
<tr>
<td>Ownership pattern</td>
<td>single owner</td>
<td>8 owners</td>
<td>15 owners</td>
</tr>
</tbody>
</table>
### Design of house

<table>
<thead>
<tr>
<th></th>
<th>well planned courtyard haveli with big rooms</th>
<th>subdivided into small dwelling units, road side rooms converted into shops</th>
<th>further subdivision, courtyard being used for parking &amp; other activities, inner side rooms for storage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Far</td>
<td>150</td>
<td>200</td>
<td>300</td>
</tr>
<tr>
<td>No. Of rooms</td>
<td>15</td>
<td>25</td>
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</tr>
<tr>
<td>No. Of floors</td>
<td>2</td>
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<td>4</td>
</tr>
<tr>
<td>Type of structure</td>
<td>Pucca</td>
<td>Pucca</td>
<td>Pucca</td>
</tr>
<tr>
<td>Condition of building</td>
<td>Good</td>
<td>fair</td>
<td>bad</td>
</tr>
<tr>
<td>Materials and technology</td>
<td>Thick stonewalls with lime mortar. Stone door &amp; window frames, stone slab roof, Flooring with small brick bats with lime plaster on it</td>
<td>partition with 6” brick wall</td>
<td>R.C.C. with cement mortar</td>
</tr>
<tr>
<td>Infrastructure facilities</td>
<td>water from well, dry pit latrines</td>
<td>municipal water supply, one toilets and bathroom shared by 45 persons</td>
<td>attached toilets in one DU other use common added later</td>
</tr>
</tbody>
</table>

Only one family on first floor is having separate toilet, rest all use common toilet on ground floor, which are in very bad condition. In this Haveli there are three families are living and two units are in a dilapidated condition in lack of maintenance as there owner of those has migrated to some outer place, thus no body to take care of the courtyard is badly maintained, it is being used for parking and storing scrap.

### Figure 9 Internal views of Haveli

Courtyard is being used for parking and other household, storage of a bookshop on ground with view of a dilapidated portion in building. Redeveloped dwelling unit having small store, dress and bath on first floor, this du has attached toilet. Redeveloped dwelling unit having small store, dress and bath on first floor, this du has attached toilet. FAR has increased from 150 to 300. No. of rooms increased from 25 to 70 but room sizes in du's are very small as 2.5x3m to 3x3.5m.

### Figure 10 Internal views of dwelling unit

Redeveloped kitchen is with platform & modern equipments and dining area. Some kitchen created with partition of room are very congested as only one person can sit there at a time and badly maintained. In the image, a small partition is being used as kitchen, a newly developed kitchen with platform and a redeveloped DU with modern material.

#### B. Haveli - 2

This Haveli is located in Chowkry Purani Basti on having an area of about 500sqm occupied by Brahmins, the original occupation of the family was dhai maa (royal nurses) but subsequently it changed. Presently some three families are in Govt services and others are involved in cloth and stationary business. This was initially double stories planned in typical courtyard pattern.
Activity Spaces: This Haveli has two courtyards; this Haveli is also in the form of fraternal cluster. It has a symmetrical plan with entrance in east. Other spaces are same as used to be in a Brahmins Haveli.

**TRANSFORMATION**

This Haveli is used as residential purpose, except some of rooms on ground floor are being used as commercial storage. Transformation took place in the form of sub-division. External courtyard is being used for parking etc.

**Table 8 Transformation Profile**

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<tr>
<td>INFRASTRUCTURE FACILITIES</td>
<td>water from well, dry pit latrines</td>
<td>municipal water supply, one toilets and bathroom shared by 45 persons</td>
<td>attached toilets in some of DU's</td>
</tr>
</tbody>
</table>

The well-planned courtyard Haveli is sub-divided in small dwelling units and courtyard being used for parking and other household activities. The roadside rooms on ground floor are converted into commercial.

Due to continuous subdivision, it is converting into apartment. No. of families increased from single to 15. FAR also increased from 150 to 400. three more floors added. The condition of structure is good and maintained.

Traditional thick walls were 1'6" thick with lime plaster, which replaced by half brick thick wall. Stone door & window frame also changed with metal or
wood. Roof is constructing with R.C.C & cement mortar.

Figure 13 view of a newly developed unit and an old toilet

A traditional room converted into modern with extension by roofing sheet. House has subdivided, one small room used for various activities like kitchen dining, drawing. The average area under each DU is 20-30sqm. Number of rooms increased from 16 to 80 but room sizes in DU's are very small as 2.5x3m to 3x3.5m. Earlier there were dry pit latrines but now days flush toilets are there but it is shared by many families. This Haveli is totally demolished and rebuilt except one room at first floor called as Mahal.

Both of these case studies shows that the transformation is taking place in the traditional Havelis because of changing lifestyle of people, need for more space, commercialization and other various reasons. Due to lack of sensitive approach, people are not concern about our cultural heritage. They do alteration in the building without any consideration for its heritage character and energy efficiency. Architectural character of building including elevation, aesthetic elements, height, and color is lost by new constructions in which people have not followed the traditional characteristics. In addition, there is lack of policy and enforcement from Govt for protection of heritage character of these traditional buildings.

 VII. POLICY INTERVENTIONS

There are multiple authorities in Jaipur viz; Jaipur Development Authority, Jaipur Municipal Corporation, public works department and, Rajasthan urban infrastructure development and Finance Corporation etc. all these authorities manages different aspects of development in city. Earlier there were conflicts due to multiple authorities, although now Jaipur Municipal corporation only looks after for the development of walled city but still there is not much groundwork have been done.

As walled city of Jaipur is a special area full of traditional buildings having multiple land uses. It needs special attention in terms of bylaws and regulation, but there is lack of special bylaws for protection of traditional buildings. There are also various policies by state and central govt but due to various reasons full potential of these policies is not being exploited viz;

- Heritage Protection as per The Rajasthan Monuments, Archeological Sites and Antiquities Act 1961; it is Specific to monuments and identified heritage building, not for all heritage buildings
- Tourism Policy of the Department of Tourism, Rajasthan; Conversion of havelis in to hotels can disturbed the visual character of walled city as there is no specific byelaws for traditional buildings
- Adopt a Monument Policy.; lack of finances and awareness among people
- Rajasthan Heritage Conservation Bill, 2015 and Policies for promoting generation of electricity through renewable energy sources; Potential of these is not exploited due to absence of technical knowledge and high installation cost
- Master Plans for Jaipur: Earlier master plan lack sensitive approach towards walled city. MDP - 2025 have provisions for development but it includes only the overall development not micro level building activities.

In addition, all these heritage acts and policies specify rules only for monuments or identified heritage properties but not for the general traditional buildings under private or public ownership. Hence, there is no control on construction activities in buildings.

Other than public there are some private organizations involved in the development works in walled city viz; Virasat foundation, INTACH and ASIA URBS and were quite successful but they were limited to a small area.

 VIII. FINDINGS

Land Use
In both case studies, the use of dwelling unit is partly changed from residential to commercial purpose. In walled city, Ground floor is totally commercialized but at some places, whole house with all floors is being used for commercial purpose. Building gets commercialized from road heads to inner side property. Traffic congestion and parking problem increased.

Socio-Economic Profile
People with good income profile purchased property outside walled city and either rented or sold the property. Use of modern equipment like HVAC, and other electrical devices increased, which require more space and energy. Lifestyle is changing, and Ownership pattern is changed from one owner to more
no. of owner because of increase in family size and large number of tenants. Sub-division & multiple ownership of properties, increase in floors and rooms, due to increasing population. Modern life style and culture, needs additions like attached toilet, platform kitchen and modern equipments etc. modernization of houses, change of façade, filtration of commercial offices in residences are coming up.

House Hold Characteristics
Increase in no. of floors due to need of more dwelling unit and increasing family size. The large size rooms and halls had subdivided in small rooms and now followed by further subdivision of small commercial pockets. The single room is being used for all types of residential activities like for kitchen, drawing, dining and sleeping purpose. Use of building is changing, no. of household is increasing, change in original space activity and more space is created to suit the requirement. Residential density is increasing. Traditional planning concept is disappearing. Due to sub-division of properties no. of floors and rooms increasing. Room sizes are very less. One- two room dwelling units are increasing. In new constructed buildings, there is no staircase and commercial users of these buildings share adjacent building staircase. Average area under each dwelling unit is around 30 Sqm, and some place it is less than 15sqm including common areas and basic amenity area which is very less.

Heritage Character
Poor structural conditions, dampness etc. necessitated renovation and reconstruction of houses. The building it tends to dilapidated, which creates a dangerous condition, also its traditional character losses. Most of the structures are pucca but due to lack of its maintenance these structure get dilapidated before their design age. The very beautiful and well-ventilated buildings had transformed in unplanned and unhygienic small commercial pockets. New materials and construction technology used losing its traditional character. Most of the houses are on rent, which are maintained but neither owner nor tenant maintains it as owner getting less rent and tenant never feel responsible.

Building Materials and Construction Technology
Load bearing structure is transformed to R.C.C. structure. The traditional lime mortar and stone wall (45-90 cm) has placed in cement concrete and burnt bricks in narrow partition of half brick walls. The traditional wooden plank beams has replaced by steel girder filled with cement concrete. Use of new building materials and technology in reconstruction, renovation and addition in house. Dilapidated building can be used, new structures with modern material are cheap to construct & easy to maintain

Infrastructure
Due to increasing commercial activity, the area is becoming very much congested and load on infrastructure is increasing. The mode of water supply is changed from ground water to municipal supply. The toilet and bath facilities have shared by large no. of dwelling units and later on in reconstructed building, there is no space for these types of facilities. Electricity lines are touching the building line, which creates a very hazardous situation.

Building byelaws & legal framework
Govt interventions lacks the sensitive approach towards walled city, as there is no special bylaws and development controls for walled city. There is total Absence of control on far and lack of enforcement. Lack of co-ordination between various organizations. Absence of a special autonomous body to govern the overall building activities. Programmes run by various organizations limited to a small area. Lack of power within the corporation to have a control over the city.

IX. Conclusion
Traditional buildings are the unconscious expression of people’s culture and the outcome of man’s interaction with the nature. The walled city of Jaipur is in its transition phase and considering the growing population and its relative demand, there is an urgent need to focus on conserving its overall character and with provision of basic infrastructure facilities to its residents. The Havelis of Jaipur is facing several crisis related to Congestion, pollution, energy losses and dilapidation. Majority of the issues faced by these Havelis of Jaipur are unplanned transformation, misuse of heritage properties, traffic congestion, haphazard parking, encroachments by informal sectors, solid waste management, etc. These problems may affect the unique characteristics, architectural value and heritage of the Havelis in the walled city. Hence, it is essential to work for the conservation and retrofitting of Havelis in the walled city.

Change at in these havelis is obvious due to population pressure and changing lifestyle of residents. It is also an essential part of sustainable urban development. However, the traditional form of building shall transform in such a way that they may be appropriate for the changing social order of the present. The key approach in this shall be to retain the integrity of building material and construction technology with minimum and reversible interventions.

Today most of the buildings are designed to separate man with the nature and the contemporary materials and construction techniques used to maintain indoor thermal quality, consumes a significant amount of energy. In vernacular buildings, passive techniques were used for the comfort in different climatic region, without mechanical means,
these buildings are better than the newly designed buildings. Traditional buildings are sustainable, with use of climate responsive material and construction techniques, Natural ventilation and advantages of solar direction was taken in those buildings.

In view of the shortage of energy, it is very much essential to review the historical origin of Architecture & Technology to restore the comfort inside the building. In addition, energy efficiency techniques to support the transformation should be explored for these traditional buildings. Thermal performance and air quality inside the buildings can be improved substantially and energy can be saved through understanding the ancient design concept. Traditional houses (Havelis) of Jaipur are good examples of passive Architecture. These havelis are designed in such a way that all people are comfortable inside a building during the hot summer. Courtyard is an important design element of passive cooling for regular fresh air supply and for day lighting in hot dry climate.

To protect this cultural heritage, formulation of special building byelaws are essential with a mechanism to assist owners, builders, developers, contractors and other related officials concerned with building construction activities in the walled city.

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