Present Condition and Causes of Decay of Tomb of Jahangir at Shahdara, Lahore

M. Y. Awan\(^1\) and N. S. Kazmi\(^2\)

\(^1\)School of Architecture and Design, University of Engineering and Technology, Lahore, Pakistan
\(^2\)Technical Education and Vocational Training Authority Punjab, Lahore, Pakistan

Abstract

All the materials used in the construction of historical buildings undergo deterioration when exposed to aggressive environments. The rate and symptoms of such a process is influenced by a number of factors, including the properties of material itself, the natural factors and human-actions. These factors either act separately or in various combinations. Conservation refers to systematic measures taken to keep the monument in good condition.

The monument of Jahangir’s tomb is about 370 years old. Several times, since its construction, it has gone through various repairs and restoration work, though never under a comprehensive conservation plan. The nature of restoration work included the restoration/repair of cenotaph, stone pavements and some facades of main building.

This paper is focused on the study and analysis of the present condition of structure of building of this very important historic monument, the ‘Tomb of Jahangir’, situated at Shahdara, Lahore.

The aim of the paper is to identify the causes of decay and deterioration of the building through a detailed visual examination carried out by authors of the paper during the year 2004.

An examination of the building has shown that there is no single cause responsible for the deterioration and decay of Jahangir’s tomb. It has been found that there are number of intrinsic (internal) as well as extrinsic (external) causes responsible for decay of the building. Thus this paper is an attempt to facilitate the work of conservator/conservation-architect by providing necessary information required for the conservation/restoration of a historic monument.

Keywords: Monument; Mughal architecture; Cultural heritage; Archaeology; decay; deterioration conservation; creation; destruction; restoration; neglect; maintenance; facade; construction techniques

1. Introduction

The tomb of Mughal Emperor, Jahangir, is one the most significant historic buildings of the Mughal period. Emperor Jahangir was son of Mughal Emperor Akbar the Great. Jahangir died in 1627 AD and according to his last wish he was buried at Shahdara, Lahore in the garden of “Dilkusha” situated on the north-western bank of the River Ravi. Now the area of whole Shahdara complex (Jahangir’s tomb, Akbari Serai and Asif Jah’s tomb) is 100 Acres, out of which area of Jahangir tomb is 59 Acres. The Jahangir’ tomb is approached through a spacious Serai, called Akbari Serai, which is a rectangular enclosure. Its interior court is surrounded on all sides by raised walkways and small room/cells. The Jahangir’s tomb is situated to the east of this Serai. The tomb is single storey square building and is set in a luxuriant square garden of “Chaharbagh” style. Each corner of the building is surmounted by an octagonal minaret which is structurally attached with main building. Jahangir was succeeded by his son Emperor Shahjahan who started construction of his father’s tomb in 1627 and completed in 1637.

As restoration of this monument has continuously been done after its first construction and lastly in year 2004, western facade of main building was restored by the Department of Archaeology and Museums, Pakistan, as shown in Figure 1.

As the building is one of the masterpieces of the Mughal architecture, it was considered appropriate to find out major causes of its decay. The causes of decay relate to various factors which have been discussed in the following sequence:
1. Causes, related to geographical location of building, such as thermal movement, rain and moisture and natural disasters

2. Causes related to nature of ground.

3. Causes related to materials and techniques used in original construction.

4. Man-made causes which include willful destruction, neglect, atmospheric pollution, vibration, wear and tear by visitors and use of poor conservation techniques.

5. Biological and Micro-biological causes.

Figure 1: Western facade after restoration. The floor of main building has slightly curved downward due to settlement.

2. Causes Related to Geographical Location of Building

These mostly concern with climatic condition to which the building is subjected all the time, such as solar radiation, temperature, humidity, rain, wind speed, floods, earthquake etc. These are now discussed in detail in the following section.

2.1 Thermal Movement

Lahore falls within the zone of extreme climate. During summer the temperature rises up to 48°C and during winter it falls down to 0°C. [1] The exposed parts of building expand more due to solar radiation, where as internal and shaded parts of building stay relatively cool. Thermal movements create stress in building material and components, which results in cracks in the material and structure. Different materials and even the same material of different colors have different thermal expansion, due to which cracks, between the joints of masonry, are developed.

The building of Jahangir’s tomb has massive masonry structure. The upward thermal expansion is controlled by compressive forces of dead load, but the horizontal movement has created vertical cracks on the upper portion of building. The roof, which is decorated with different colored stones, has also developed cracks between joints at roof; through these cracks, the rainwater percolates and causes damage to the interior of building, having fresco painting and mosaic tile work.

2.2 Rain and Moisture

In the city of Lahore, the average rainfall is 20 inches annually [1]. Rain damages the masonry above the ground and penetration of rainwater through capillary action causes decay of structure internally. The rainwater picks up soluble materials along its path and destructive crystallization process occurs when water evaporates. Salt crystallization results in powdering of surface, cracking in material and sometimes even complete disintegration of stone masonry. Contour scaling also occurs due to repeated wetting and drying cycles of stone masonry.

The facade of Jahangir’s tomb is of red sandstone, which is a porous material. Cavernous decay can be witnessed on the facade, where the cavities have developed and marble inlay has either corroded or fallen down. Scaling and contour scaling on stone surface has also taken place due to repeated wetting and drying cycle. At some places, salt crystallization has resulted in a form of powdering and fragmentation of surface as it exerts pressure on the pores of material.

2.3 Natural Disaster

Jahangir’s tomb, one of the Shahdara monuments, is situated at a distance of about 1/2 km from the river Ravi, which always remains a source of serious threat to the monument at the time of flood. The Shahdara monuments were damaged during the floods of 1938, 1955, 1973 and 1988. The flood water remained standing at Jahangir’s tomb for five days during the flood of 1988 and its level varied in height from 6 feet to 10 feet [2] (Figures 2 & 3). This natural disaster has prolonged action and reaction on the monument. The flood has affected the north-west minaret of building. The lower portion of this minaret has bulged outward and its veneering has mostly disintegrated (Figures 4 & 5). Its shaft and walls also have major cracks (Figure 6). The earth shaking shocks induce dynamic movement in all three dimensions of building. Although, Lahore is not in serious seismic zone, even then cracks have developed at the corner of walls, around openings and arches at Jahangir’s tomb; which shows that the structure might have weakened due to long life span.
3. Causes Related to Nature of Ground

The nature of the ground and stability of soil, on which the building is erected are of an utmost importance. Underground water-bed, salt, and nature of soil all determine the stability of the building.

When the load transmitted by the foundation is not proportioned to the behavior of ground, it develops cracks in structure.

The river Ravi is flowing very close to the Jahangir’s tomb, which is transmitting salinity to the masonry of main structure by the capillary action. The present water table is at 15 feet below the ground and slushy soil is available at the depth of 7’ feet. Rise in water table is a threat for structural stability of the monument, as it has changed the characteristics and behavior of subsoil. One cause of deterioration in case of heavy structure of the tomb is excessive concentrated load upon the foundation. It is felt that the soil strength has reduced under the main building as the floor of main building has slightly curved downward from central portion. Floor is not an isolated element acting independently; it has inter-relationship with walls and roof etc. As such structural movement has developed major cracks on floor, side-walls and on vaulted roof of main building (Figure 7, 8 & 9).

The present water table further rises up during rainy season; resultanty the dampness has become a permanent feature of building. At present, dampness is the worst enemy of the monument; it has attacked...
on every material and deprived them of its strength and cohesiveness. The salts available in the ground have dissolved the lime mortar and have caused serious disintegration of masonry joints. The kankar lime plaster has peeled off from the surrounding rooms of main building and also from boundary wall (Figure 10). The dampness has also resulted in the growth of lichens, fungi and bacteria, which has blackened the stone surface and disfigured it.

4. Causes Related to Materials and Techniques Used in Original Construction

At some places deterioration is due to bad quality of building material or due to improper building techniques, which was applied at the time of construction by original builders. It is found at many locations in Jahangir’s tomb, where the stones are not laid along their bed (Figure11). Similarly a large number of iron dowels have been used not only to join the stone slabs veneering but also for reinforcement of masonry (Figure 12).

The splitting and shattering of stone is very common at Jahangir’s tomb and at some places chunks of...
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Stone veneering have disappeared because of rusting & expansion of iron dowels.

5. Man Made Causes

Man is a creative artist and a destructive agent at the same time. Man-made causes of decay are complicated and have widespread implications. These are by-product of industrial activity, urbanization and population pressure.

5.1 Wilful Destruction

The monument has suffered a lot at hands of the Sikh rulers, who stripped off most of ornamentation and marble railing of roof to décor Golden Temple at Amritsar. The monument was also used as a residence by General Amise (a French officer of Sikh Army) and Sultan Muhammad Khan, who also damaged its ornamentation by making fire places in the hall of mausoleum. During British period it was used as coal depot, which further contributed to its decay [3] & [4].

5.2 Neglect:

Neglect and ignorance are possibly the major causes of destruction by Man [5]. A number of issues such as social, economical, political and administrative etc. are the underlying causes of neglect. The boundary wall of Jahangir’s tomb is badly affected by neglect and ignorance. The absence of pointing and grouting is resulting in instability of structure. The north and south pavilion of the garden are at advance stage of decay (Figure 13). Its masonry has disintegrated and almost all the decoration has peeled off.

The eastern pavilion has virtually collapsed (Figure 14). The Department of Archaeology has no plan in near future to restore these pavilions.

Encroachments along the northern and southern boundary walls have badly affected the grandeur of the garden (Figure 15). People are making construction without knowing to what extent they are damaging the built heritage. The Archaeology Department feels handicap to control the issue due to prolonged litigation with these people. The wild growth on grounds. The seeds of autonomous plants, deposited in joints and cracks have grown on deeply into the masonry and they act just like wedges and separate structural elements from each other.

Figure 12: Use of iron clamps, to support the masonry, are very common in Jahangir’s tomb

Figure 13: South pavilion at advance stage of decay

Figure 14: Eastern pavilion virtually collapsed.

Figure 15: Encroachments and wild growth along boundary wall
other. Sparrows and pigeons have made nests in the building. The excreta of birds promote decay and disfigure the beauty of building [6].

5.3 Atmospheric Pollution

Air is polluted primarily by automobile exhaust emission and industrial waste products. The tomb is located close to a large industrial area of Shahdara and Grand Trunk road. The surface of stone has become roughened and pitted due to pollutants of air. Pollution has greatly affected the stone especially “sang-e-badal” and marble, which are calcareous stones. Lime mortar and lime plaster is also affected by pollution, with the change of calcium carbonate into calcium sulphate, which is water-soluble. The structure has become weak as the lime mortar is leached away due to acidic rain. The suspended particulates such as dust, fumes, soot etc. have also disfigured the surface of stone, especially fresco work of surrounding rooms of main chamber.

5.4 Vibration

Mechanical vibrations transmitted to the subsoil by heavy traffic, road and railway, have proved to be destructive for the historic building. The vibration can cause loss of foundation strength by affecting subsoil, and loss of structural strength in super structure.

The railway line was laid during the British period, which is at a distance of about 400 meters from Jahangir’s tomb (Figure 16). The highway is also at about 1 km from Jahangir’s tomb. Both provide vibrations to subsoil, which have produced structural cracks in the building, specifically vaulted roof of main building and north-west minaret.

5.5 Wear & Tear by Visitors

Due to inadequate number of guards, un-authorized visitors are very common. The visitors damage the monuments by writing on walls, climbing with different elements of building, playing cricket etc. (Figure 17).

5.6 Poor Conservation Techniques

Poor conservation is the result of lack of technical knowledge, regarding restoration work. Repairs are often done inexpertly or using unsuitable materials, which react un-favorably with the original material, causing further damage. Altering original design and detailing and unplanned conservation activities in wrong sequence also comes under poor conservation techniques. The monument is under extensive attack of poor conservation techniques. Some are mentioned as under [6].

Restoration work is being carried out by the Department of Archaeology and Museums without any conservation plan. It may damage the originality of monument. The face lifting of building is being carried out without structural bonding (Figure 18).

Figure 16: The railway line near tomb was laid during British period. A train passing near the tomb can be seen.

Figure 17: Writing on wall is very common by visitors.

Figure 18: Face lifting of facade without structural bonding.
The use of cement is very common for repair and restoration work at Jahangir’s Tomb; whereas according to Bernard M. Feilden, “cement is number one enemy of historic buildings” (Figure 19). Its use is harmful as it is too strong in compression, adhesion and tension so it lacks elasticity and plasticity when compared with lime mortar used in historic buildings. As such cement is not compatible with lime mortar. A number of places are seen where a lot of touching has been done with cement, which has resulted in further cracks in the adjoining area.

The workmanship is poor; wrong alignment of pattern and change of design details can be witnessed at many places (Figure 20).

### 6. Biological and Micro Biological Causes

Bio-deterioration means any adverse changes in the material properties due to growth of biological and micro-biological organisms. The bio-deterioration of material involves mechanism of different kind of disintegration and decomposition processes (Figure 21). Due to extensive dampness the growth of microorganisms is very common on the surface of stone facade. Lichens and fungi have blackened the whole surface, especially the dado panels. The enzymatic activity of micro-organisms has also resulted in loosening, staining cracking and falling of building material (Figure 22). The surface of white marble has green, red and brown spots due to algae.
7. Conclusion and Recommendations

A detailed visual examination of the building has been carried out by the authors during the year 2004 in a comprehensive and systematic manner. This included examination of interior and exterior of the building, structural members; horizontal as well as vertical, and materials used in construction and decoration. This also included a detailed inspection of the historic record of the building lying with the Department of Archaeology and Museums. The record provided valuable information on important developments and the nature of restoration works spreading over the last more than three centuries.

The examination and analysis reveals that the building is in acute need of structural stability, instead of its face lifting. The efforts should be shifted from restoration work to regular maintenance of building. Regular pointing and grouting is necessary to strengthen the structure. The structural problem of north-west minaret needs expert’s investigation before taking any remedial measure.

Prime cause of deterioration is salinity in masonry due to capillary action, which needs specific control measure to prolong the life of monument. It is not only creating structural problems but also damaging the decoration details of mosaic work and fresco. Encroachments along boundary wall also need serious legal action to restore the surrounding environment of monument.

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