

2009

Conservation

CHAUNSATH KHAMBA

TASK

Landscaping the Chaunsath Khambha forecourt.

PURPOSE

- Chaunsath Khambha, a unique *Akbari*-era monument, was not visible following the construction of a wall in 1960's, separating it from the monuments forecourt.
- To enhance the historic character and cultural significance of the monument implement a sensitively designed landscape scheme.

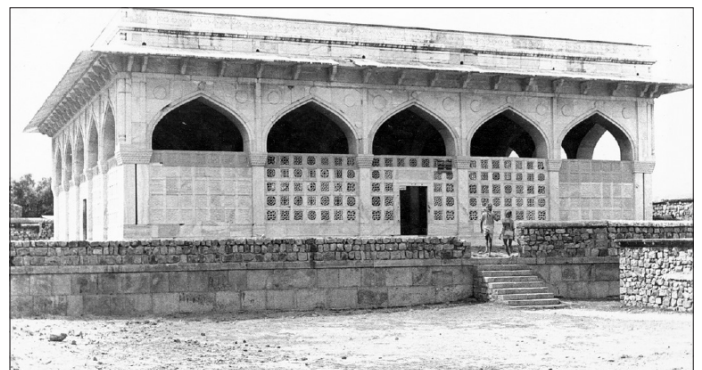
ACTION TAKEN:

- The forecourt, where stands the Urs Mahal is used for ceremonies associated with the Dargah twice a year. Following community consultations and required approvals a landscape design was finalised in 2008.
- The masonry wall separating the monument was demolished and replaced by a metal fence. The design of the metal grille was based on the stone lattice screen on the Chaunsath Khambha.
- The random stone paving of the courtyard was removed and a new paving layout implemented.
- This included a formal central axis and enhancing the access to the monument.
- The steps to the monument can also be used as a stage for quwwali performances.
- The historic well that was, in recent years clad with sandstone was restored to its original, historic appearance.

NEXT STAGE:

Planting, benches and signage need to be installed for the monument.

In the 1960's, to protect from vandalism and encroachment, the magnificent Chaunsath Khambha was enclosed in a rubble masonry wall. Removal of this wall, coupled with the implementation of a sensitively design formal landscape scheme has significantly enhance the historical character of this space, used for community functions and the annual Ur's ceremony of Hazrat Nizamuddin Auliya and Amir Khusro Dehli.



Chaunsath Khamba

The tomb of Mirza Aziz Kokaltash, known as Chaunsath Khamba on account of the sixty-four marble pillars dates from the early 17th century and is unique in architectural design and ornamentation.

The area comprising of Chausanth Khamba, Urs Mahal courtyard and Mirza Ghalib Tomb, form the largest open space in Nizamuddin Basti. The three presently segregated sites will be integrated by the landscape design thereby enhancing the cultural significance of the place and allow appropriate community usage.



The large forecourt has been paved, in a formal design, reflective of Mughal style. This required the existing paving to be removed though portions of the stonework could eventually be re-used in the new design.



The random rubble masonry wall built in the 1960's, disfigured the historic relationship of the monument to its forecourt. This wall has now been demolished and replaced with a protective metal fence that allows visibility of the monument



Craftsmen install the sandstone pillars that support the metal fencing.

Conservation

CHAUNSATH KHAMBA

Chaunsath Khamba

The historic well - during conservation works

The historic well in the Chaunsath Khambha courtyard was clad in brick masonry and sandstone cladding – disfiguring its architectural and historical character. The modern layers have now been peeled away restoring the original stone masonry wall and sandstone edging



Chaunsath Khamba

The forecourt - during landscape works



01



02



03

Before Conservation



During Conservation

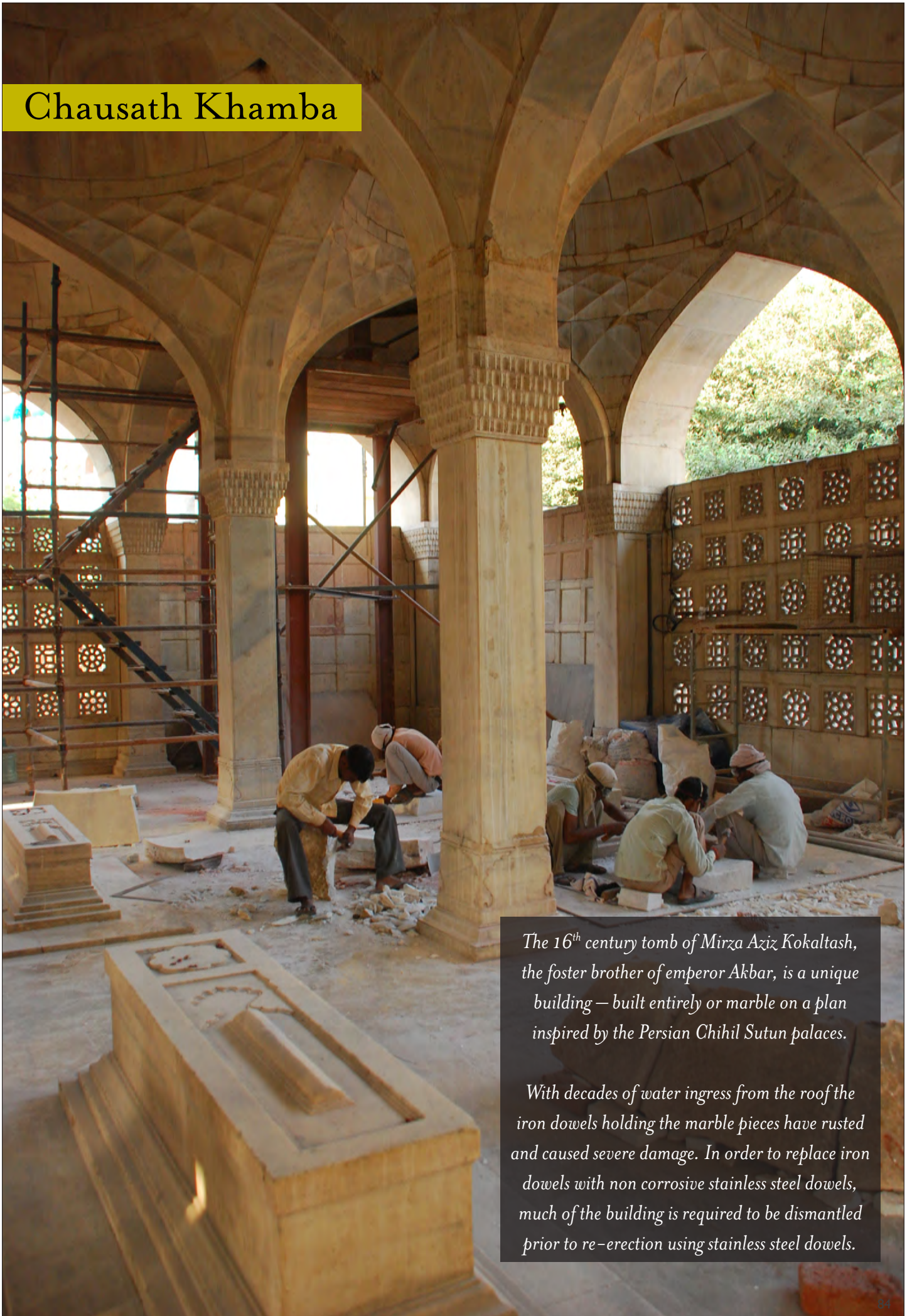


..... During Conservation



2011

Chausath Khamba



The 16th century tomb of Mirza Aziz Kokaltash, the foster brother of emperor Akbar, is a unique building – built entirely of marble on a plan inspired by the Persian Chihil Sutun palaces.

With decades of water ingress from the roof the iron dowels holding the marble pieces have rusted and caused severe damage. In order to replace iron dowels with non corrosive stainless steel dowels, much of the building is required to be dismantled prior to re-erection using stainless steel dowels.

Nizamuddin Basti Conservation

CHAUSATH KHAMBHA



TASK:

Conservation of this unique marble building including taking necessary steps to ensure long term preservation.

PURPOSE:

The structural stability of the tomb structure is threatened by the severe erosion of iron dowels and resulting in cracking of the marble elements.

ACTION TAKEN:

- Exhaustive documentation including a 3D laser scanning carried out of all the surfaces at the onset. This was followed by a condition mapping of each stone piece of the monument including quantification of new stones required for repair/ replacement.
- After careful investigation and trials it was agreed that repairs could only be carried out by dismantling the marble pieces of the dome to be followed by replacement of Iron dowels with stainless steel and carry out repairs to damaged stones prior to refixing.
- The corner south-east chamber of the monument has been taken up for repairs on an experimental basis in September 2011.
- After proper scaffolding and shuttering was installed the marble rings were dismantled one-by-one and carefully marked.
- Training of craftsmen to implement the conservation work has been carried out and all works are being supervised by a Conservation Architect.
- White Cement applied to fill up the broken joints on the marble stone surfaces has been removed carefully. Small marble pieces prepared as per the sizes for the indenting and fixed with the main stone member.
- Few marble pieces decayed beyond repair, replaced with new stone. Specific order was made for procuring matching marble for the repair works.
- The damaged marble stones of the pendentives have now been replaced with new marble pieces with same ornamental pattern.
- Three rings of the south-east corner dome have been re-installed.

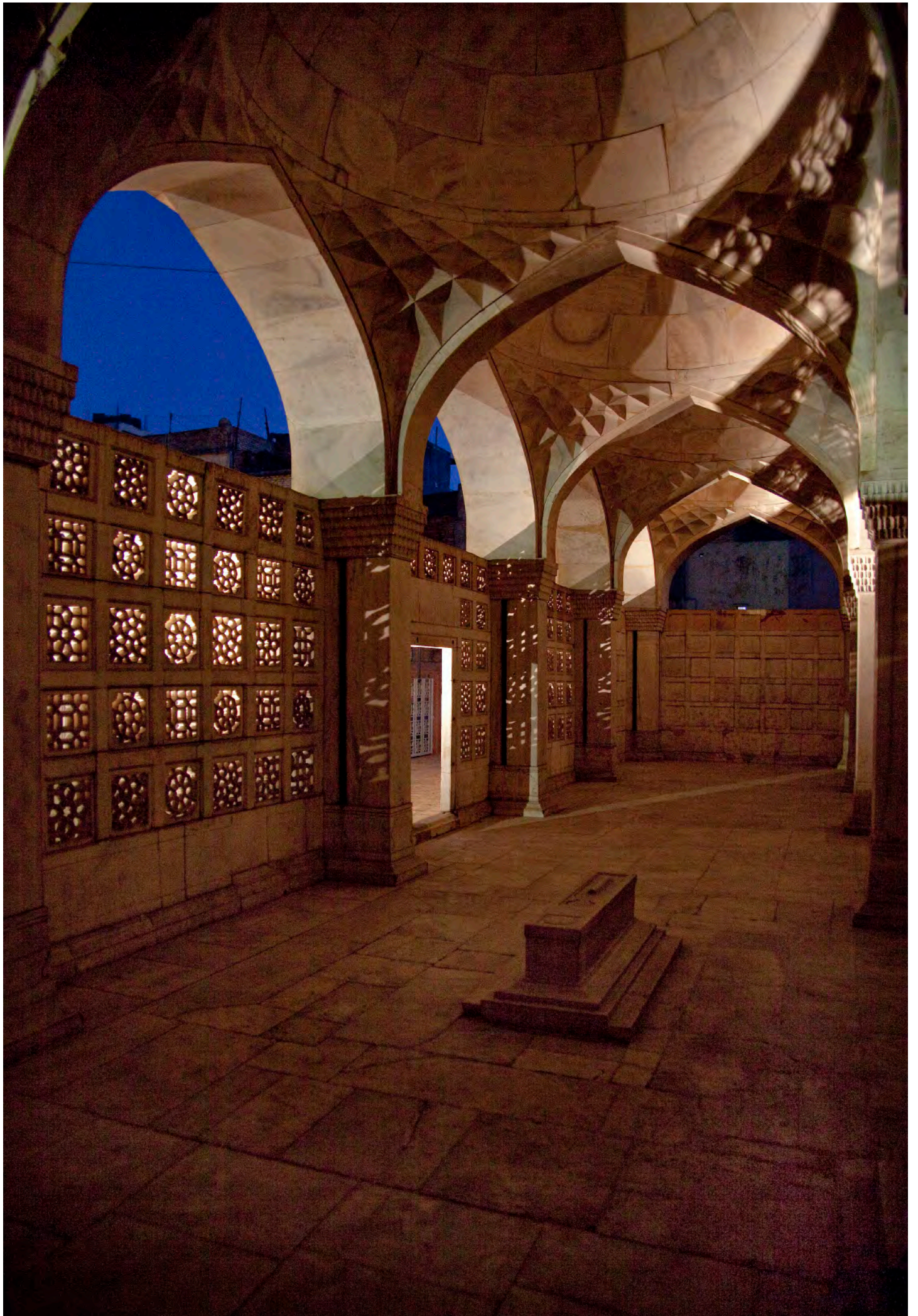
“The German government is proud and honoured that we can give our humble contribution to the wonderful work that the Aga Khan Foundation is doing to preserve the rich cultural and spiritual heritage of this holy place,” said Ambassador Matussek during the signing ceremony.

NEXT STEPS:

- The work on the dome no. 1 will be completed in two months of time period.
- Ordering required stone and scaffolding for the entire building.
- Commence conservation works simultaneously on four domes – segregated from one another.
- Manually dismantle entire roof concrete up to 30 cm thick and replace with lime concrete with adequate slope and water proofing materials to prevent water ingress and further deterioration.



2012



CHAUSATH KHAMBA CONSERVATION

The plan of this unique 16th century marble building is inspired from Iranian garden palaces and in turn inspired the Emperor Shah Jahan's Diwan-i-khas of the Red Fort. In one of the most complex conservation efforts ever undertaken, each marble piece, most weighing over a 1000 kilos, from the 25 domed cells, is being dismantled to remove the 16th century iron dowels many of which have rusted and damaged the marble. The iron dowels are being replaced with non-corrosive stainless steel prior to fixing the marble back in its original position. In the process, meter deep cracks in the underlying masonry are being carefully stitched and repairs required to many of the marble pieces carried out.



The manner in which this complicated conservation work is being undertaken bears remarkable tributes to Indian master craftsmen

CHAUSATH KHAMBA

Conservation

It is a unique structure built of marble and named so on account of the 64 (Chausath) pillars of marble that hold the 25 domes. The marble pieces of the domes are attached to the masonry with iron dowels that have deteriorated as a result of water ingress from the roof and caused severe damage to marble and masonry. The conservation initiative aims to replace iron dowels with stainless steel dowels thus requiring the marble to be dismantled from each of the domes, repaired and then restored to its original position.



▲ Stone carvers fix the repaired marble elements back to their original location on the structure

ACTION TAKEN:

Documentation & Condition Assessment

- Prior to the conservation works, 3D Laser scanning of the whole complex was done for the monument. Architectural measured drawings were prepared from the 3D Laser scanning data and the on-site measurements that were taken to form a complete set of drawings which lead to an improved understanding of the building leading to informed conservation decisions.
- Stone by Stone condition assessment of the domes, exterior and interior façades of the monument was done manually on the images by visual inspection of each stone its defects and its causes.
- The foundation of the monument was inspected by digging a pit of size 1 metre x 3 metre were excavated at different areas up to the depth of 5 meters to assess the condition of foundation of the tomb.
- Several options for the conservation works for stone replacement and indenting were discussed with the ASI core committee comprising to finalize the process for conservation.
- Prior to the conservation works, matching stones of required sizes was procured.

Dome repair works

- Past, yet recent, repairs at Chausath Khambha have included filling cavities created by broken marble edges with white cement. This needed to be carefully removed.
- Conservation works have now been completed on eight domes. These have required the full-time supervision of a Conservation Architect and Engineer.
- Repairs are now undertaken on three domes simultaneously by team of craftsmen trained on site over the past two years to undertake this work.
- Following the erection of sturdy scaffolding, each stone in the dome was numbered. Since the keystone is not removed, this is held in place with shuttering for the duration of the conservation works.
- The stones are dismantled ring-by-ring under careful supervision. These are also stacked as per their numbers and respective ring.
- Each stone is then closely inspected to list required repairs by indenting or to assess if it is not possible to repair and requires replacement.
- Since the stones are curved both in the horizontal as well as the vertical surface and are thus unique, every effort is made to ensure that the stone can be repaired and restored to its original location.

- Traditional material and manual techniques of stone dressing and indenting are being used to maintain the authentic interior appearance of the domes.
- The corroded Iron dowels are then removed carefully without damaging the stone and then replaced with stainless steel dowels.
- Each stone weighs from 200 to 350 kilograms and requires up to five craftsmen to remove and stack. The stones being structural stones and are interlocked with each other. Proper precision thus needs to follow while removing the stone without damaging the stone.
- Shifting of stones from the scaffolding has to be done with great care with the help of rope and requires 4-5 persons without damaging the edges of the stone.
- Marble stones, decayed partially, are repaired by replacing decayed portion with a new stone indenting prepared by the master craftsmen carefully to match with the original piece.
- The cracks in the masonry above the stones have been found to be as deep as 1 metre and up to 150mm wide. Repair work includes pressure grouting and stitching of crack.
- After indenting repair is done the stones are re-erected at their respective position. The process of re-erecting has to be done with immense precision as the stone can only be fixed at their original position due to their curvature and size.
- Initially eight months were required to complete the conservation of one dome as several discussions and investigation were required on each step. After repairs were completed on the first dome the repair methodology was established for the conservation of other domes. Soon it is expected that the craftsmen will be able to complete conservation works on one dome in under three months.

Arch repair works

- Decayed arch on north western bay have been repaired carefully.
- It was a challenge to carry out restoration work in this dome as the 350mm thick arch stones supporting the structure above had cracks and it was not possible to take stones out and repair.
- Decayed stones replaced completely and indenting stones replaced the partially damage stones
- A team of master- craftsmen working on the dome took one month to complete the indenting repair of arch stones.

Craft based approach is an exact reversal of the 20th century engineer approach and each of the 25 domes is to be dismantled and reset after each individual stone is repaired by master craftsmen using the same tool's building techniques and traditions used by their forefathers in building the monument in the 16th century ►

Dust lifts as Chausath Khamba restoration begins

... The 25 reverse domes of the Chausath Khamba monument in Nizamuddin Basti are being dismantled for conservation treatment - a unique technique that experts claim has no parallel anywhere in the country... Every stone and marble piece was individually documented, after which it was learnt that the marble pieces in the domes were fixed together by iron dowels, and with water penetration the iron had rusted, corroded and expanded, causing severe damage to the marble. "In addition, the cavities caused over the years by broken marble edges were filled with white cement, but the process of deterioration continued unabated," said an official... "We will make the roof water tight using traditional repair methods before the onset of the monsoon. This will require filling the cracks and replacing the top cement layer with a traditional lime concrete layer," explained Neetipal Brar, conservation architect with AKTC.

Source : *The Times of India*, 29 - April, 2012

More on the web:



Scan here, for more information on the conservation of Chausath Khamba





Terrace repair works

- A layer of cement concrete was found to have been applied on the terrace; since this was causing more damage than being protective, this was removed.
- Lime slurry applied to the roof surface leaked through the almost 2m thick roof to the ground level, demonstrating the level of water ingress that had caused such severe damage to the structure.
- This discovery was followed by a sustained lime grouting effort from above to fill in cracks that had developed in the masonry.
- A layer of lime concrete with additives like Jaggery and Bael fruit pulp (*Belgiri*) was laid maintaining the original slope levels.
- Clogged water spouts on all sides of the structure were re-opened to ensure quick disposal of rain water.

Repairing enclosure wall

- Damaged and decayed red sandstone façade of the enclosure wall towards the tomb of Mirza Ghalib have been documented and measured.
- All the decayed red stone pieces are now replaced with new stones of similar geological characteristics and architectural details.
- All stones are made by the master craftsman as per original pattern and profile and now fixed as per original constructional details.



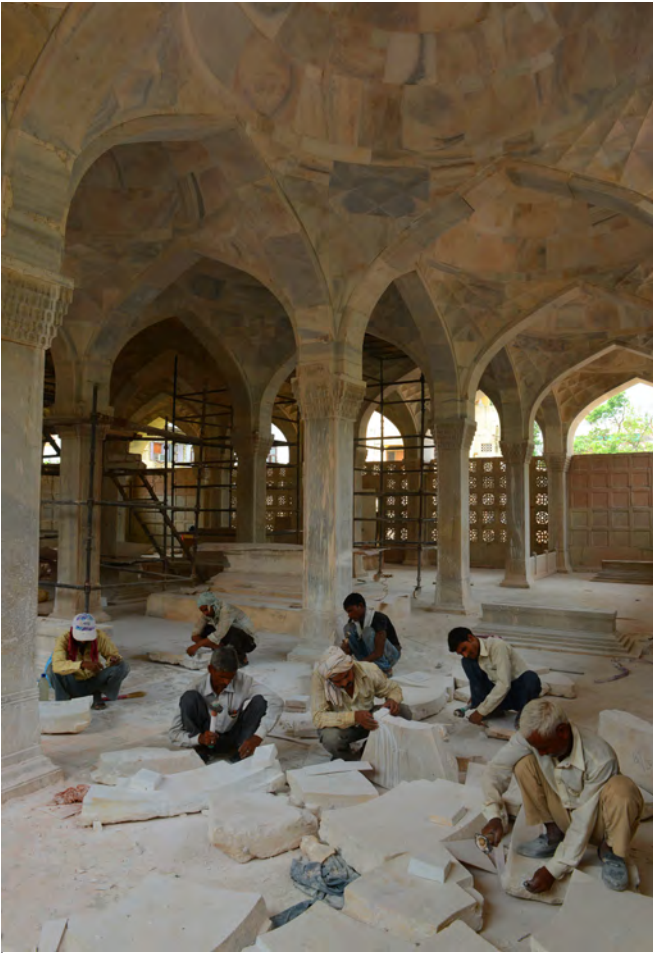
NEXT STAGE

Conservation work at Chausath Khmabha will continue through 2014.



◀ The 230 mm thick layer of cement concrete from the roof was removed and pressure grouting was done to repair the network of cracks in the roof. New layer of lime concrete with additives like Jaggery and Bael fruit pulp (*Belgiri*) was laid maintaining the original slope levels. Clogged water spouts were opened to avoid rain water from stagnating.

2013



CHAUSATH KHAMBA

This 16th century tomb of the Kokaltash family is of a unique design and plan inspired by the Iranian garden pavilions and later used for the Diwan-i-Khas and Diwan-i-Am at the Red Fort. The structure is set in its own enclosure and comprises of 25 domed chambers supported on 64 marble columns. Repairs commenced in 2011 and eight domes had been repaired by 2012. Each dome required complete dismantling of the marble blocks followed by repairs to marble and masonry prior to restoring blocks to their original position.

Dome Repair Work

ACTION TAKEN:

- Conservation works were completed on twelve domes in 2013 and thus 20 domes have now been conserved.
- Prior to dismantling the marble cladding, almost 25 cms thick, each stone is carefully inspected, recorded and numbered.
- The inspection and recording allows damage to each stone to be assessed and appropriate repairs - indenting or replacement - planned.
- Documentation and numbering of stones is important as each stone is unique with curvature on both the horizontal and vertical and varies in size and thickness. Some of the stones are 1300mm X 650mm in size and 250mm to 280mm thick, thus weighing over 350 kilograms.
- The stones are then carefully dismantled ring by ring without damaging edges of the stones and the 300m thick brick masonry above the dome.
- Once the stones are stacked and numbered a close inspection of the brick masonry lining is done. Any cracks or imperfection found is repaired by pressure grouting or stitching of cracks if required.
- Following the dismantling of stones, team of skilled craftsman repairs the partially decayed or damaged marble stone carefully to match the original piece. Joinery detail is worked out to keep the indent pieces in place even after the stones are fixed at an angle. The joinery detail varies from stone to stone and thus requires close supervision.
- After the indenting repairs the stones are re-erected in its original position. The process has to be carried out with enormous precision as even a minor variation may require the ring to be dismantled once again.

Key Stone Repair in Arch

- At dome No. 13, the keystone of one of the internal arches had decayed and crushed between the 350mm thick arch stones due to imbalance or settlement.
- It was a challenge to repair the key stone without dismantling the arch stones.
- A team of craftsmen, working under close supervision, required five months to repair the keystone without disturbing the original setting of the Arch.

Stone Repairs On Parapet Wall

- The red sand stone coping had decayed and cracked due to weathering and .
- Decayed stones which were beyond repair have been replaced with all such stones dismantled from the parapet with immense care.
- Following the dismantling of stones, levels were fixed for re-laying of the stone coping. Joinery detail was worked out for fixing stones to prevent water seepage through the joints. The stones as big as 1500mm X 500mm X 50mm were lifted up to the terrace and fixed in lime mortar.
- All the iron dowels were replaced with non-corrosive 314 grade stainless steel dowel. The decayed cement plaster was removed and new lime plaster was done as per the original detail.

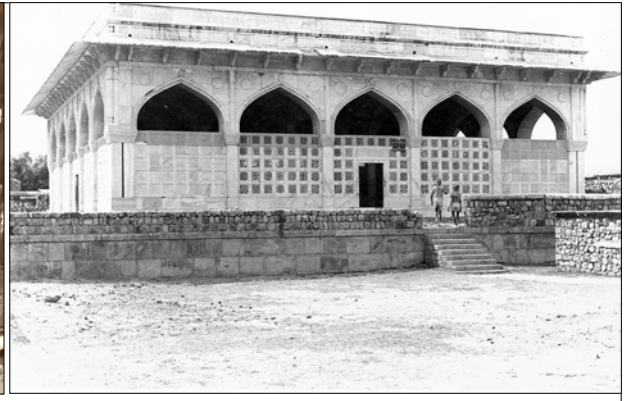
NEXT STAGE:

Conservation will continue in 2014 and will include restoration of remaining 5 domes, Lattice screens, Eave stones, External arches and Urs Mahal Gate.

(Below) Various stages of conservation of one dome - in all 25 domes were restored in Chausath Khamba



2014



Chausath Khamba

Chausath Khambha was built in AD 1623 - 24 to serve as a tomb for Mirza Aziz Koka, foster brother of the great Mughal Emperor Akbar. It is so called on account of the 64 (chausath) monolithic marble pillars (khambha) and stands in close proximity to his father, Atgah Khan's tomb, at the edge of the Dargah of Hazrat Nizamuddin Auliya.

The study of the structure revealed that over 80% of the stone blocks had severe cracks and past repairs had inappropriately only filled up burst portions of stone blocks with white cement – masking the damage but allowing the deterioration to accelerate. In view of the unique architectural design, construction techniques of the Chausath Khambha as well as the fact that each stone itself was unique in shape and size, it was agreed that all original stone was required to be retained.

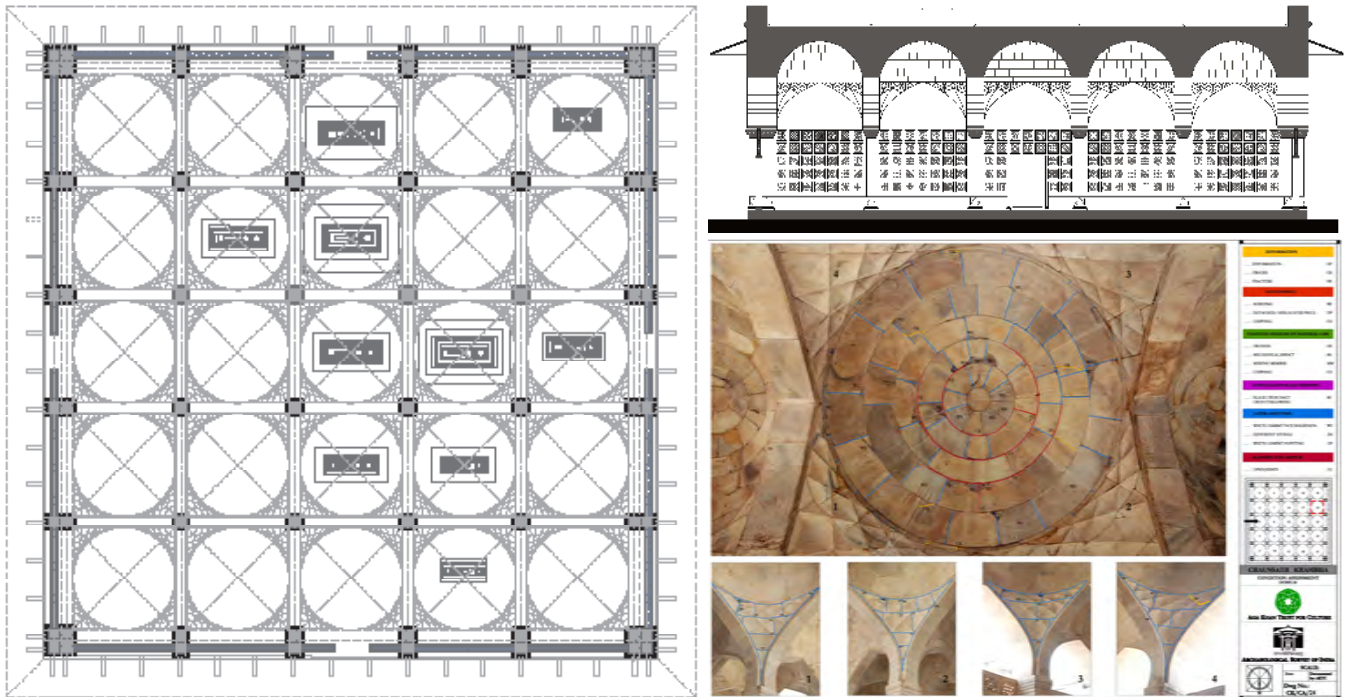
Before Conservation

The marble blocks of the 25 domes were tied to one-another and embedded in the brick masonry over the domes with iron dowels. The rain water spouts from the inaccessible roof got blocked resulting in large quantities of rain water collecting on roof. This resulted in the rapid deterioration of the roof and large scale water ingress from the roof leading to the corrosion, rusting and expansion of the iron dowels. The significant pressure from the expanding iron dowel led to bursting of the marble blocks in all parts of the mausoleum – domes, arches, facade, pendentive and even the column capitals – threatening structural failure and collapse of the structure.

Prior to commencement of conservation works, studies were carried out to achieve better understanding of the historic fabric of the building and its relation with one of oldest precinct in Delhi. Architectural data was collected from Zafar Hasan's – "Monuments of Delhi (Vol. 2) DELHI ZAIL listing", Carr Stephen's - "The Archaeology and Monumental Remains of Delhi" and Ebba Koch's - "Mughal Architecture" and classified for further referencing timeline of the monument was established and all archival paintings and images were collected and compared for evidences (*Above*).



Material Deterioration due to past repairs in white cement – masking the damage but allowing the deterioration to accelerate; Chipping of Marble elements like domes, arches, facade, pendentive, jaalis and column capitals; Rusting of iron dowel due to water seepage led to bursting of the marble



Documentation

A high definition survey, using 3D laser scanning technology, was carried out on the structure as a precursor to conservation works. This was followed with a stone-by-stone assessment of the entire structure to map the profile and defects on each individual stone coupled with photo and video documentation. To complete a structural analysis pits were dug to study the foundations – which were surprisingly found to reach a depth greater than five metres.

Archival research revealed sketches dating from the early 19th century, descriptions and a continuous record of photographs from the mid 19th century. Stone-by-Stone condition assessment of the domes, exterior and interior façades of the monument was done manually on the images by visual inspection of each stone its defects and its causes. Past, yet recent, repairs at Chausath Khambha included filling cavities created by broken marble edges with white cement. This needed to be carefully removed.

The conservation works at Chausath Khamba were co-funded by the Embassy of the Federal Republic of Germany. These works were extremely complicated and dangerous as it was required to dismantle each of the 25 domes to repair marble blocks and cracks in the masonry prior to re-fixing stone blocks on their original location.

Each stone was closely inspected to list required repairs by indenting or to assess if it is not possible to repair and requires replacement.



Conservation Philosophy

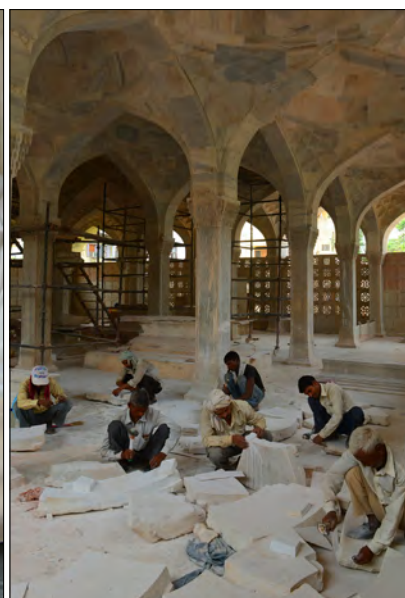
The study of the structure revealed that over 80% of the stone blocks had severe cracks and past repairs had inappropriately only filled up burst portions of stone blocks with white cement – masking the damage but allowing the deterioration to accelerate.

In view of the unique architectural design, construction techniques of the Chausath Khambha as well as the fact that each stone itself was unique in shape and size, it was agreed that all original stone was required to be retained. However, steps needed to be taken to replace iron dowels with non corrosive stainless steel dowels of matching size. Roof repairs to halt water penetration were also urgently required.

The forecourt – largest open space in Hazrat Nizamuddin Basti – was to be landscaped to create a performance venue for the Qawwali musicians residing in the historic neighbourhood

Craftsmanship

The manner in which this complicated conservation work is being undertaken bears remarkable tributes to Indian master craftsmen. The stone carvers, using traditional tools and building techniques took eight months to successfully repair the first dome – on the northwest corner – thus establishing the repair methodology for the mausoleum. The stones are dismantled ring-by-ring under careful supervision and stacked as per their numbers and respective ring. Traditional material and manual techniques of stone dressing and indenting are being used to maintain the authentic interior appearance of the domes.



DOMES NO.	NO. OF IRON DOWELS REMOVED	NO. OF IRON DOWELS REMOVED	NO. OF IRON DOWELS REMOVED	NO. OF IRON DOWELS REMOVED
1	45	45	0	0
2	12	25	16	2
3	22	24	4	2
4	24	4	4	1
5	24	54	4	-
6	41	21	1	-
7	1	22	1	1
8	15	1	2	2
9	107	27	12	1
10	29	24	22	7
11	35	1	25	12
12	37	1	1	1
13	25	25	2	2
14	24	14	2	3
15	1	1	1	2
16	1	1	2	-
17	24	25	7	-
18	31	12	4	-
19	15	2	4	1
20	25	1	2	2
21	1	1	2	4
22	22	2	2	2
23	25	1	2	1
24	1	1	1	1



The Conservation Challenge

The preservation of Chausath Khambha was possible only if the iron dowels could be removed and thus it was necessary to commence a conservation programme that required dismantling each of the 25 domes. Such an effort had never before been undertaken anywhere in the world.

The multi-disciplinary conservation team comprising experienced engineers, craftsmen and conservation architects could only access the iron dowels from below as the documentation had revealed over 1m thick masonry above the marble domes. Each stone was thus required to be numbered and mapped.

Terrace

The masonry above the domes had 1 metre deep and 4" wide cracks through which the water was seeping inside the building. These cracks were required to be repaired urgently to stop further deterioration. The 230 mm thick layer of cement concrete from the roof was removed without disturbing the underneath structure and pressure grouting was done to repair the network of cracks in the roof which were approximately 2 meters in depth. A new layer of lime concrete with additives like Jaggery and Bael fruit pulp (Belgiri) was laid maintaining the original slope levels. Clogged water spouts were opened to avoid rain water from stagnating.



During Conservation

After removing the white cement from the broken joints, tell tails were fixed over the joints for structural monitoring for further observation by trained conservation architect and engineers.

Each stone weighs from 200 to 350 kilograms and requires 4 to 5 persons to remove and stack the stone. The stones being structural stones and are interlocked with each other. Proper precision needs to follow while removing the stone without damaging the stone. Shifting of stones from the scaffolding has to be done with great care with the help of rope and requires 4-5 persons without damaging the edges of the stone. The corroded Iron dowels are then removed carefully without damaging the stone and then replaced with stainless steel dowels. The process was constantly supervised by conservation architect and site engineer.

Various stages of conservation of one dome: Numbering each stone; Dismantling the marble blocks and repairing of cracks in the masonry; and Repair of marble blocks with indents of matching stone where these had burst by master craftsmen using tools, techniques used by the original builders and Re-installation of marble blocks in the original location.





The removed stones are further closely inspected before indenting repair. After examining, the stone decision on repair methodology is taken. The process is time consuming as each stone is unique in terms of its size and curvature on both the axis.

Creating Economic Opportunities

The conservation effort at Chausath Khamba created at least 25,000 man days of work for traditional stone craftsmen and allowed training younger craftsmen. Youth from Hazrat Nizamuddin Basti have been trained to serve as heritage volunteers guiding tourists, pilgrims and school children through the seven centuries of built and living heritage of Hazrat Nizamuddin Basti.

At the onset of the Nizamuddin Urban Renewal Initiative, baseline surveys revealed that under 1% of the women residents had any kind of livelihood. Self Help Groups established here have been trained to make souvenirs in paper and textiles with motifs from Chausath Khamba and Humayun's Tomb.

The Nizamuddin Urban Renewal Initiative has aimed to create a model for urban conservation in the Indian context by also improving education, health, and water and sanitation infrastructure. The Quality of Life for local residents and visiting pilgrims has been enhanced by diverse project components ranging from building community toilets, landscaping neighbourhood parks, housing improvement, vocational training opportunities, early childhood care and development, cultural revival, amongst others.

(Below) German Ambassador Mr. Michael Steiner was the Guest of Honour on the completion ceremony of Chausath Khamba on 16-November 2014

