Christ the King Monument, St. Patrick’s Cathedral, Karachi.
State of Conservation Report

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INTRODUCTION

Christ the King Monument is situated within the boundaries of plot on which stands the St. Patrick’s Cathedral, located at the eastern end of Shahrah-e-Iraq (Clark Street), within the governing limits of Karachi Cantonment. It is a listed heritage property of Karachi, notified and protected under the Sindh Cultural Heritage Preservation Act 1994; bearing the enlistment number 1995-158 and 1997-217 in the records of Department of Culture, Government of Sindh. The property demarcated and listed under this reference includes a large plot having different building blocks, among which the center of focus is the centrally located St. Patrick’s Cathedral built in 1878. Besides the Cathedral there used to be another stone structure within this lot, housing a library and reading room, which was unfortunately pulled down and the present building of kindergarten school was built at this location.

Christ the King Monument is placed directly in front of the Cathedral at the axis of its main entrance. It was conceived by the local branch of Apostleship of Prayer in 1927 and was completed in 1931 under Popacy of ’Pope Pius’ by following Mr. M.X. Andrade’s design. Its investiture ceremony was held on October 17, 1931; blessed by His Excellency Mgr. Kierkels C. P.

THE SITE AND ITS LOCATION

The site being located on a busy artery of Karachi, i.e. Shahrah-e-Iraq (Clark Street), allows convenience in terms of accessibility both with private as well as public transport; and due to its prominent presence serves as a major reference landmark of the city. It forms part of the historic core of Karachi, clustered together with a number of institutional and religious landmarks established by the Christian community of the city. The plot of St. Patrick’s Cathedral and Christ the King Monument shares its boundary with the adjoining plot of St. Joseph’s Convent for Girls. Further down the street on one side is the St. Joseph’s College for Women and on the other side is the St. Patrick’s High School and its neighbor the St. Patrick’s Women College. The independent compound of St. Patrick’s Cathedral and CTK Monument has ample open spaces, clearly visible from main road. On this huge plot the CTK Monument covers only a small area of approximately 390 sq. yds. The open spaces around the monument are largely devoid of much vegetation or landscaping - currently having only one Neem tree standing at some distance from the structure. There are a number of more mature and older trees on the site but these are mostly along the periphery of the plot. A dense cluster of trees also exists around the Parish house.
BACKGROUND TO THE PROJECT AND ITS OBJECTIVES

The documentation and restoration of Christ the King Monument at St. Patrick’s Cathedral is a research based project initiated by the administration of St. Patrick’s Cathedral in response to the decay and damages that are presently faced by this important historic landmark of the city, due to which the monument is under threat and requires maintenance or restoration efforts to safeguard it from further damage. To execute and supervise the project a Technical Committee has been formed comprising of professionals representing different areas of expertise required to address the issues presently faced by the monument. The Technical Steering Committee comprises of the following members:

- Mr. Arif Hasan
- Mr. Mushtaq Dawood (Consultant structural works)
- Dr. Noman Ahmed
- Dr. Masood Rafi (Consultant Earthquake Vulnerability Analysis)
- Dr. Anila Naeem (Consultant Conservation/ Restoration)
- Mr. Roland De Silva
- Mr. Menin Rodrigues

The Heritage Cell – Department of Architecture and Planning, NED University has been appointed as part of the team of collaborating consultants for the above mentioned project; primarily assigned with the task of complete documentation, preparation of the state of conservation report and developing proposals for the conservation/restoration of the monument.

The project is being carried out in three phases; the first two being preparatory phases and the last one for actual implementation.

**Phase I: Documentation (April 2012)**

The first phase included detailed documentation of the monument using on-site measured survey and photographic methods. Through this first stage of the project a set of complete drawings is produced, on an as is basis. These base drawings were then used to map the different forms of structural and material problems identified on the monument.

The following drawings were produced as part of the documentation set.

1. Site Plan (Locating the structure of the monument in reference to other structures on the plot)
2. Plans (for the different levels of the monument)
3. Elevations (all four sides of the monument)
4. Sections (covering all details of the interiors and exterior)
5. Details (covering the measured drawings of features that require restoration interventions)

Prior to documentation no measured drawings were available thus work had to be initiated from scratch; commencing from April 2, 2012, by a three member team of HC-DAPNED, under the supervision of Ar. Tania Ali Soomro. Through an extensive five days field work, data was collected on basis of which the first draft of measured drawings was produced and delivered by the end of April 2012. This was followed by an analytical review of problems and issues of the site and mapping these on the measured drawings.

The second phase of the project comprises of preparation of a ‘state of conservation’ report which includes in it a detailed description of the identified issues and problems related to the maintenance and structural stability of the monument. The report first identifies the values and characteristics of this listed property, which are required to be appreciated and retained in the proposed scheme; and further lists the existing problems/alterations in the original building materials and plan scheme, along with their recommended proposed remedies and/or repairs. The report also incorporates a review on the previous interventions that have been carried out on the historic structure over the years. It also records the discussion and views of the Technical Steering Committee on the identified problems and their causes; and the approved approach towards suggesting remedial restoration interventions. The section of the report on analysis of the problems and alterations leads to proposals of remedial measures recommended to be taken into account for the restoration of the building.

In the light of identified causes of decay and damage to the site, guidelines for conservation are recommend in this report which would help guide all the associated professionals in the project to develop their proposals in accordance with the regulations and accepted approaches of heritage conservation. The proposals for interventions/repairs finalized in consultation with the Technical Steering Committee will be submitted by the property owners to the Department of Culture, Government of Sindh for seeking NOC to proceed with works on site.

**Phase III: Execution of Work on Site**
The third phase of the project includes actual implementation of proposed interventions. At this stage HC-DAPNED will be involved only with top supervision and monitoring for the conservation/restoration interventions as and when requested.
DESCRIPTION OF CHRIST THE KING MONUMENT

The CTK Monument in front of St. Patrick’s Cathedral is located on the axis of its front entrance approximately 65ft. away from the building. The centre piece of the monument is a marble obelisk at the tip of which a metal cross is mounted; together these have a total height of 54ft. from existing ground level. At the base of the obelisk, approximately 28ft. above ground level is the pedestal on which the statue of Jesus Christ (carved in marble) is placed. Jutting from the obelisk, a little above the are sculptures of two cupids holding a crown over Jesus Christ’s head. On the two sides, 2’-8” below the platform of Christ’s figure are the marble statues of two angels; standing on the semicircular architrave platform created above the free standing colonnade having three columns on both sides of the obelisk. The columns are fluted, and have Corinthian capitals. The ends of the semi-circular architrave are decorated with lantern shaped sculpture having lion face carved on the four legs and claws at their base. The altar platform placed at the base of the pedestal of Christ’s statue has an urn shaped base, decorated with floral and leaf motifs. All together these elements make the central piece of the monument, which is placed at a platform 10’-8” above the ground level. The three tiered base of CTK Monument is set within monumental stairs on all four sides. Access to the altar platform from the front side is through two flights of stairs, the first having nine steps, followed by a landing platform at 3’-8” that runs all around the monument base connecting the first flight of steps on all four sides. The second flight of stairs on the front side has fourteen steps and brings one directly to the landing of the altar. The access from the two sides stops at the first landing beyond which one has to walk around to approach the altar landing, either from the back or the front. The approach from back side has a mid landing at 7’-2” after which there are two flights of seven steps each on both sides culminating at the level of the altar platform.

The monumental steps are decorated with bottle shaped balustrades culminating at ends with 3’-6” high pedestals topped with urn shaped elements or lamp posts. The pedestals at first landing level on the two sides of first flight of steps are mounted with lamp-posts on marble columns having a height of approximately 5’-6” topped by lantern shaped lamps (these have globe lamps in a picture dated 1950). The balustrades and handrail are made of cement concrete. At the centre of the balustrade curve edging the first landing are additional pedestals mounted with statues of four angels, facing the statue of Christ at a diagonal axis. The two on front side have eyes raised towards Jesus and hands folded in prayer, whereas the two at the back have lowered gaze with folded arms.

The monument is a manifestation of love and devotion to Christ the King - designed by Mr. M. X. Andrade and built with finely polished white marble imported from Carrara, Itlay through M/s Anthony Coutinho & Co. It is said that the import duty on this was waived by the Karachi Port Trust authorities. All the sculptures are carved in marble having intricate details. The
flooring is finished with white marble tiles and exterior wall surfaces have marble slabs in upper areas and white cc tiles in the lower level walls. The construction work was supervised by Mr. August Rodrigues who was a superintendent engineer at public works department in Bombay. The monument was a gift by Major Quodros of Cincinnatus Town (now Garden East) built at a cost of Rs. 81,500/-.

Under the raised podium of the monument is the crypt room that can accommodate approximately 100 people at a time. This area is entered through doors located at the first level platform from the back side. The doors located on both sides of the second flight of back steps give access to two semicircular staircases that lead down to the floor level of the crypt hall. The flooring in this interior space is also of marble but having a patterned design using combination of black borders and white tiles. Natural light into this space enters through six circular windows on each sides; three of which are along the curve of the staircase and the remaining three along the length of the hall. These are decorated on the outside with floral wreath motifs molded in cement concrete en-framing these openings. From inside these windows have a square opening profile. The gathering area itself is visually divided by two circular columns in the middle supporting the beams on both axes. The front side of this gathering space has a flat roof decorated elaborately with plaster of Paris moldings and panels dividing this front ceiling into three rectangular divisions. Beyond the point of columns the roof of this space slopes down following the soffit of the front stairs. This sloped roof area has been re-strengthened during 1990s with iron sections inserted at equal intervals along the entire length of the slope.

Between the two circular staircases is the sarcophagus chamber having a glass opening in the front. The front of the sarcophagus chamber is richly decorated with pilasters and arch forms having floral cornice bands carved in plaster of Paris. A marble pedestal in the center has a light bulb mounted on it – depicting a candle; this might have originally been the incense table. In front of the chamber is a raised platform for the priest heading the service mass. The wall behind this platform has a niche in which a mural depicting heaven is mounted. Behind the sarcophagus chamber is a narrow corridor that leads to a dark space having another chamber at the back. This area used to have another mural depicting hell; but this is no longer in place. Both of these murals were created by Mr. Vaz specially invited from Goa for this commission.
South West (Front) Façade of Christ the King Monument

FIGURE 2
FIGURE 3
View of the Crypt Hall under the raised podium of CTK Monument
SITE ALTERATIONS/ INTERVENTIONS

The site and structures existing within the property line of St. Patrick’s Cathedral and CTK Monument are well kept in comparison to other historic buildings and monuments in the city. The site has however, undergone few alterations; but largely retains its original character and proportion of built and open spaces. The few additions on the lot are sensitively placed away from the main monuments and do not impair the visual impact of the Cathedral or the CTK Monument in any way. Although having a minor impact on the overall ambiance of the site these new additions to the lot seem to disregard the axial planning of the site and indicate that the site has developed without any master planning considerations.

Built in 1931 the CTK Monument has already undergone two rounds of major repair alterations; one in the 1970s and the second during 1990s. These alterations mostly addressed repairs and restorations required as remedies to the damages observed in the structure. From an in-depth observation of materials the following alterations are identified as not being part of the original. These include:

- Iron sections for strengthening - inserted underneath the sloping slab of congregation area in front of the Crypt.
- Repair mortars applied along the junction of floors and walls all over the exterior areas.
- Repair mortar in-fills in spots with broken or dislodges marble titles.
- Lamp posts on both sides of front and back approaches (two of the four are broken).
- Change of lamp shades on original marble lamp posts (evident from the picture dated 1950).
- Flag mast at the base of back access stairs on right side (no longer in working condition).

Most of these mentioned alterations either do not compliment the site and its original layout (as is the case of lamp posts and flag mast) or are in a damaged state at present resulting in becoming a source of further damage to the monument. It is recommended that all of these later alterations are reviewed in terms of their present compatibility with the monument and decision for retaining or removing them in the restoration process is taken categorically for each of these.
Repair mortars have developed cracks giving way to water penetration

Iron bars inserted underneath sloping slab for additional strengthening

Repair mortars applied along junction of horizontal and vertical planes

Cracks filled with repair mortar

**FIGURE 4**
PRESENT STATE OF CONSERVATION/ MAINTENANCE

The CTK Monument having remained in continuous use has been kept in a good state of preservation, however the interior space at the lower level shows lack of upkeep and maintenance since it is no longer in use for religious ceremonies or congregations due to the present state of structural damages appearing in form of visible cracks and splitting of structural members. The most affected structural members are the two columns at the sides of the Crypt, supporting the semi-circular staircases leading down from the entrance doors at both sides. The beams at these locations also show damages of high degree intensity. Moisture stains along the walls and the sloping roof slab are indicative of the fact that water seeping in at various locations has been the main cause of damage presently seen on the structural members as well as the finishing materials of this interior space.

The exterior of the monument is better preserved showing some forms of deterioration that are a result of natural decay and climatic factors. However, the decorative architectural details and elements used for embellishing the raised platform have severe deterioration in several locations. Many elements including the balustrades, lamp posts and urns/bird baths are broken and their disintegrated fragments are lying around the site.

The various damages in structural elements and the different forms of material deterioration presently observed in the CTK Monument are mapped in detail as part of the documentation process; shown in the following images. In general the most critical issues are related to the deterioration of structural members at few specific locations, visible in the form of deep cracks. These damages are primarily due to water penetration inside the building through various sources identified and discussed in the following section on causes of decay. Other than the structural damages, other forms of material deterioration and decay related to both weather and water penetration include issues like disintegrated mortar joints, cracks and fissures in decorative finishes, soiling and weathering of external stone surfaces, macro and micro biological growth, dislodged or broken elements, etc. A third group represents the insensitive alterations such as the inappropriately applied repair mortars, electrical fitting and wiring, etc.

The mapping of all forms of damages and deteriorations helps understand and identify the causes of damage and deterioration. The suggested remedies take this understanding into account, thus attempting to first rectify or eliminate the source of problem and then approach the repair and maintenance measures.
**LEGEND**

- Cracks
- Repair mortar joints
- Open mortar joints
- Neon Lights
- Marble insertions/patchwork
- Exposed electric wiring
- Broken electricity fittings/switch boards
- Dust accumulation
- Soiling
- Black crust
- CC Cladding tiles with cracked joints
- Bird's droppings
- Broken elements
- Macro biological growths
- Discoloration
- Wax stains
- Cavities/holes
- Paint chipping off
- Moisture stains

**SOUTH-WEST (FRONT) ELEVATION**
LEGEND

- Cracks
- Repair mortar joints
- Open mortar joints
- Neon Lights
- Marble insertions/ patchwork
- Exposed electric wiring
- Broken electricity fittings/ switch boards
- Dust accumulation
- Soiling
- Black crust
- CC Cladding tiles with cracked joints
- Bird’s droppings
- Broken elements
- Macro biological growths
- Discoloration
- Wax stains
- Cavities/ holes
- Moisture stains

NORTH-WEST (LEFT) ELEVATION
**LEGEND**

- Cracks
- Repair mortar joints
- Open mortar joints
- Neon Lights
- Marble insertions/patchwork
- Exposed electric wiring
- Broken electricity fittings/switch boards
- Dust accumulation
- Soiling
- Black crust
- CC Cladding tiles with cracked joints
- Bird’s droppings
- Broken elements
- Macro biological growths
- Discoloration
- Wax stains
- Cavities/holes
- Paint chipping off
- Moisture stains

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**SOUTH-EAST (RIGHT) ELEVATION**
LEGEND
- Cracks
- Repair mortar joints
- Open mortar joints
- Neon Lights
- Marble insertions/patchwork
- Exposed electric wiring
- Broken electricity fittings/switch boards
- Dust accumulation
- Soiling
- Black crust
- CC Cladding tiles with cracked joints
- Bird’s droppings
- Broken elements
- Macro biological growths
- Discoloration
- Wax stains
- Cavities/holes
- Paint chipping off
- Moisture stains
CAUSES OF MATERIAL AND STRUCTURAL DECAY

i. Water Penetration and Seepage

Moisture inside buildings penetrates either from the subsoil or from any other localized source inside the building. The site does not show prominent signs of rising damp from the ground. At certain locations, however, moisture stains are observed on the external masonry surfaces. The pattern of moisture stains and damages caused by water on different elements and materials is indicative of the fact that the main sources of water penetration have been:

- water penetration or seepage through damaged slab
- water penetration through cracks in masonry (rain or washing)
- water penetration from windows (rain or washing)
- water penetration through door opening
- watering of small green (lawn) spaces on all four sides
- watering of flower pots placed on steps/planters

All of these sources of water penetration have caused localized damages in areas affected by the spread of water from each one of these sources. The forms of damage caused include soiling, staining, discoloration, peeling/chipping of paint and micro/macro biological growth in masonry. The structural members or architectural elements in areas where water penetration has occurred show more severe damages as the corroding reinforcement bars have resulted in cracks or splitting.

The crypt area shows more concerning issues of water seepage as compared to the rest of the monument. Water accumulating on exterior horizontal surfaces seeps in through open mortar joints of the marble tiles. This problem is particularly severe on the front steps as the sloping roof of the underneath crypt hall is most severely affected. The later installed reinforcement iron sections have also rusted due to continued water penetration through this slab. Besides the sloping slab, the other area showing severe structural damages are the two
The columns and beams supporting the semicircular staircases show severe damages. The water stains and soiling on the floor in these areas indicate that water comes in through the gap between floor and door; and also seeps through the sills of the three windows. This collects underneath the stairs and has been the main cause of damage in these two areas. Other damages due to water penetration is the discoloring of the flooring and cladding tiles especially around the edges. This is due to water penetration through the gaps and cracks in mortar joints. Besides these a major crack runs horizontally along the south-east (right) and north-west (left) side masonry walls along the lintel which is clearly visible from both inside and outside.

Among the external architectural elements the most damaged are the balustrades, but only in areas where faulty slopes of stairs or flooring causes water to stand at certain pockets. The locations where planters are still existing or used be kept are locations showing worst damage. Some of the marble lamp posts have also been damaged due to rusting of the iron dowels used in their erection.

These sources of water penetration need to be dealt with first before any repair work is undertaken on the already damaged structural and architectural elements.
Cracked balustrades due to erosion of iron bars

Horizontal crack along lintel – from inside

Water stains on external surfaces

Horizontal crack along lintel – from outside

FIGURE 7
ii. Faulty Slopes in Flooring

The problem of poor surface water run-off slopes is among the primary causes of water penetration into the structural members. This stagnating water pools at various locations traps water resulting in its slow penetration into the sub-floor through open mortar joints or fine cracks in mortar/tiles. The only permanent solution to this problem is to rectify the surface slopes and ensure proper drainage of all areas. The possibilities of this were discussed at length during the steering committee meeting held on 5th May 2012; and in the light of risks of damage to original materials it was decided that any attempt for taking off the tiles and relaying them with proper slopes will not be done. It was decided that treatments for sealing the open joints, surface cracks, etc. will be sought and the issue of water penetration due to collecting water puddles will be controlled through maintenance measures.
FORMS OF DAMAGE AND DETERIORATION

1. Dirt Accumulation and Soiling on Horizontal Surfaces
The site of CTK Monument is located in a manner that it faces direct exposure to main road and other forms of climatic factors. Thus the monument has acquired dirt accumulation and adherent soiling particularly on the horizontal surfaces and crevices of carving details. Being located within the city center the monument is exposed to environmental pollution due to heavy traffic and public transport. The surfaces having dirt accumulation and soiling are identifiable by the change in coloring of stone, especially on horizontal ledges and cornices. Vertical surface areas where rain water does not penetrate and wash-off the collected dirt also indicate soiled areas. Some portions of floor areas where the water accumulates and is left to dry off naturally also show soiling patterns as the dirt adheres in these areas after the evaporation of water. The loose dust particles can be easily brushed or washed off from these surfaces by use of gentle brushing/scrubbing technique and water nebulizer jets. More stubborn stains would require intense cleaning with stronger chemicals (See Appendix I for instructions on stone cleaning).

Exterior surfaces showing dirt accumulation and soiling  FIGURE 9
2. **Black Crust Formation**

Besides general soiling due to consolidation of atmospheric dust, various locations of the monument also show another form of stone deterioration i.e. the black crust formation. Presence of hazardous particles in air (air pollution) and constant presence of moisture results in formation of such type of black crust. The back crust forms on unexposed or shaded areas where sun exposure is very negligible, i.e. is usually the crevices of carvings or gaps of minor details or on vertical surfaces where rainfall striking on damaged horizontal ledges, produces a run off film down the wall. Black crust is a combination of runoff bio-film, dried pigeon droppings and dust accumulation. When dry this film turns into black crust adhering to the stone. The black crust is most likely to cause excessive weathering of the stone during humid climatic conditions, when water content in air is very high. Black crust is on CTK Monument is seen under cornices and other shaded areas under projections, in the carved areas of Corinthian capitals and in the crevices of the carving details in all statues. In addition to being physically damaging to stone the black crust visually disfigures the carving details.

*Black crust formations defacing the carving details*  
**FIGURE 10**
Pattern of soiling and black crusts of stone surfaces

**FIGURE 11**

**LEGEND**

- Dust Accumulation
- Soiling
- Black Crust
3. Bird Droppings

The monument does not have dense foliage or vegetation in its immediate surroundings, but there are a few large trees within the site and its adjoining properties. Additionally the site is within the city center which has a substantially dense population of birds; specially pigeons, sparrows, eagles and crows. The sight of birds perching on the monument is not very common, yet the problem of bird droppings is observed on the monument. The problem is not very severe all over the monument, only some areas are more seriously affected - particularly the top of obelisk, the upper part of all sculptures/ statues and cornice bands/ ledges. Floor areas immediately below the perching spots also show accumulation of bird droppings. These give an unsightly appearance; and may also cause some damages to the stone because of their acidic content.
4. Macro and Micro Biological Growth
The problem of biological growth as observed in the CTK Monument is due to localized issues of water penetration. Watering of potted plants placed on steps and in some of the urns/planters are the main source due to which macro biological growth has occurred in various locations; particularly in north-east (back) side and north-west (left) side along the corner joints of the steps leading to the second level. The moisture trapped in mortar joints or cavities has resulted in promulgation of this biological growth. As the plants are growing bigger they are dislodging the marble tiles and damaging the flooring.

Micro biological growth is also observed on a few areas, including the surface of wall cladding tiles at a few locations which are not exposed to direct sunlight and on the last riser of the first flight of front steps.
5. **Damaged and Soiled Flooring Surfaces**

The original white marble flooring on all exterior platforms and steps is at present in a fairly well preserved state, except for a few locations where minor damage is observed in form of cracks and broken tiles. Some of the flooring tiles are also dislodged due to macro biological growth and also due to cracks in their mortar joints which have over the years widened due to water penetration and the damages this has caused in the internal structure of the stone. These damaged areas can be dealt with spot repairs/replacements. Other than these few locations the rest of flooring tiles are intact and firmly in place. At a few spots some damage in the form of discoloration is also observed; probably a result of staining from spilled drinks or other chemicals/liquids. Being exposed to exterior weathering conditions and atmospheric pollution the floor has an accumulated layer of soiling, which is more intense in areas where the slopes allow rain water to stand till it evaporates through natural process. The entire floor requires proper cleaning and polishing.

The flooring of the interior spaces inside the crypt hall is in a better state of preservation, and no signs of damages were observed. However, due to prolonged disuse and lack of regular cleaning/maintenance this flooring presently appears in a bad state. The accumulated dust layer and soiling requires proper cleaning. Measures need to be taken to prevent any damage to this original flooring during the repairs of structural members.

![Marble flooring of interior crypt area in a poor state of maintenance](image14a)

![Marble flooring of interior crypt area in a poor state of maintenance](image14b)
Various forms of damages and discoloration/soiling on exterior floor surfaces and stairs **FIGURE 15**
6. Oil/Wax Stain
The marble surfaces immediately below the altar (service platform) is severely stained and blackened by candle fumes and oil marks from lamps (Diyas) that are lit at the altar as a religious practice by occasional visitors. This practice is not followed regularly throughout the year but only on specific occasions. Due to the blackened surfaces and wax stains, the altar surface gives an unpleasing visual impact. The damaged/stained areas will have to be cleaned properly and provision of sand tray needs to be considered as a permanent fixture for this location so that all candles or lamps are placed inside these to prevent the staining on marble surfaces.
7. Nailing Marks and Cavities/ Holes
The semi-circular colonnade on both sides of the central pedestal of Christ’s statue is lit up with neon lights at night. The installation of these lights is done by using iron nails and wires hammered into the marble slabs. The rusting of these nails is starting to stain the marble. At the moment the problem is not very severe but further rusting might cause unsightly stains and can even cause cracks in the marble slabs. A proper system of installing these neon lights needs to be considered, using steel clips or nails.

At various location on the monument like cornices, underneath circular windows, in birds bath and lamp posts, etc. finely carved holes are observed. The objective of these could not be ascertained. These vary in sizes, but those at similar location are identical. At certain locations metal insertions are observed in these cavities which over the period of time have rusted, causing ugly rust stains in the surrounding marble. The utility of these needs to be investigated and if no longer required the iron insertions needs to be taken out and the cavities/ holes filled with repair lime mortar to prevent any penetration of water into the monument through these open holes in marble.
FIGURE 18

Holes or metal insertions observed at various locations - their purpose is not understood.
8. Damaged and Disintegrated Architectural Details

The architectural details including balustrades, lamp posts, urns/planters made with cement concrete or marble have disintegrated at various locations. The pattern of damage on all of these directs toward moisture penetration that has resulted in erosion of the metal clamps or reinforcement inside the material, causing fissures and cracks and eventual disintegration of the elements. The damaged lamp posts being of solid marble can be put together by anastylosis techniques if all of the broken pieces are found on site. But applying a similar approach to the disintegrated c.c elements is not advisable. The elements/pieces that have been damaged beyond repair will have to be replaced with new ones of similar design and detail. These should however, have a mark of date indicating the year of repairs. The c.c. elements that have just fallen off and lying intact on the site can be reused after checking their material strength.
FIGURE 20

Damaged architectural details
9. **Electrical Wiring and Fittings**

Electrical wiring and fittings have been haphazardly added in different areas of the monument over the years, and presently causing defacing of areas as well as the interior space of the crypt hall where switch and fuse boards are broken and wires are exposed and dangling from various open outlet points. Light fittings are also installed in the outer wall surface. These also have exposed wiring clipped to the tile cladding.

A proper electrical plan needs to be developed for the exterior and interior lighting of the monument. The wiring needs to be appropriately fixed using conduit channels. The light fixtures added later to the monument need to be replaced with more appropriate light fittings. It is recommended that instead of installing lights on the stone façades the monument should be lit up in the evenings by using lights installed on the ground or mounted on posts around the building.

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*Exposed electrical wiring, broken boards and haphazardly installed light fixtures*  
**FIGURE 21**

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PROPOSED REMEDIAL MEASURES AND CONSERVATION INTERVENTIONS

In view of the structural and material problems identified in CTK Monument the following list of remedial interventions are proposed. These include repairs, consolidation and replacements where required; and maintenance/ cleaning measures. The general approach is to retain the original materials and design scheme with minimal additions or change. The most impactful in proposed addition is the structural consolidation frame. Other than this only small changes in details are proposed in two or three locations to eliminate the causes of damage. Each of the proposed interventions are described briefly as follows:

1. Consolidation/ repair of structural elements

Penetration of water from different sources inside the crypt area has resulted in damage of the different structural members. Based on discussion in the steering committee meeting the structural consultant has proposed remedial measures which are described in detail in Appendix 1. In brief the decision of the committee was to approach this problem in two steps. First to treat all the damaged elements of existing structural system with the objective of consolidating these and ensuring that further damage does not occur. The second phase will be the installation of the extra structural framework as an additional support to the existing members. This is being designed galvanized steel, and will be installed in a manner that it can be dismantled any time in the future if desired with causing any damage to the existing structure. The additional iron sections installed for reinforcement of the sloping roof in previous maintenance efforts (now badly rusted) will be replaced with new sections of non-rusting material, as recommended by the structural consultant. (Detail drawings to be reviewed by steering committee before finalizing these).

2. Repair/ sealing of open joints in external marble tile flooring

The marble tile flooring although in a fairly good state of preservation requires spot maintenance/ repair measures in locations where some parts are broken or the tiles are dislodged due to cracks or growth of plants. The damages are not of severe nature thus can be rectified with simple interventions. The entire flooring however, needs to closely inspected for open joints which will be treated with epoxy based sealants. The choice of sealant will be based on the following three factors; UV resistant, colorless and should not discolor or disintegrate after weathering. Sample tests must be undertaken before application on the entire monument. Any large cavities or open joints should be filled with lime based mortar. After all gaps and joints are properly sealed the overall cleaning should be undertaken. More adherent stains should be removed with appropriate chemicals, their choice depending on the type of stain to be removed. After satisfactory cleaning of the entire floor a protective coating may be applied as a preventive measure against future soiling and dirt accumulation. Test panels will be applied before treating the entire surfaces.
3. Repair/ sealing of cracks in walls

The vertical surfaces of the entire monument need will be closely inspected for any cracks or open mortar joints, before any cleaning of surfaces is attempted. The horizontal cracks along the side walls (above circular windows) are more severe and need to be treated according to the specification of the structural consultant proposed for RCC and masonry repair. Cracks of a minor degree are visible in the mortar joints and other non-structural elements. These will be treated with lime based fillers. Any loose mortar should be brushed off, and the gaps or cracks will be repaired with fine lime mortar of approved finish color & quality. The damaged repair mortar of previous maintenance jobs must also be checked closely and if loose or disintegrating it should be carefully taken out and the gaps/ open joints repaired with proper grouting and filling material. For larger cracks or open mortar joints lime based repair materials are to be used. See appendix III for preparation of lime mortar.

The white tiles used for cladding of wall surfaces have micro cracks on the surface allowing higher water absorption and retention capacity. Due to this trapped moisture the discoloration of material is seen extensively on vertical surfaces in lower level walls. To achieve reduced water absorption a water repellent (transparent) coat can be applied on the external surfaces after repair, cleaning or polishing of these surfaces.

4. Cleaning and repair of interior floor

The original flooring both in interior spaces as well as exterior areas is of marble tiles, which at present is in a fairly good state of preservation, except for a few locations on the steps where minor damages are observed. These damaged areas would require spot repairs/ replacements. The entire flooring needs proper cleaning to remove soiling and other stains, and polished after the repair and cleaning measures are satisfactorily undertaken. Application of a protective coating may be considered, but the decision on this should be taken after checking the weathering behavior of applied material through sample test panels. See appendix IV for proper guidelines on polishing of marble surfaces.

5. Repair of damaged false ceiling

A small part of the false ceiling is damaged (most probably due to the underpinning bamboos). This will have to be repaired with spot repair technique; carefully cutting out the damaged area and patch-working with reproduced replacement of damaged portion.
6. Electrical works – wiring and fixtures

The haphazardly installed electrical wiring that is presently defacing both interior spaces and exterior surfaces need to be properly organized and installed in a proper manner. Proper conduit channels must be designed with a better aesthetic appearance. The external light fixtures on walls should also be replaced with more appropriate light fittings, ideally installed around the monument fixed either on ground or on posts.

7. Provision of raised thresh-hold at the two entrances

The two entrance doors leading down into the crypt area are fixed with a gap of approximately 3 – 4 inches above the finished floor level. The flooring level on the exterior side of the entrance is in line with the flooring level of the staircase landing on which the door opens directly. Due the same level on the outside and inside and the gap between the door and the finished floor level rain water from external surfaces drains inside and has been the cause of damage to the structural members of the staircase. To resolve this problem of water penetration from underneath the door it is proposed that a thresh-hold stone slab is fixed at the inner side of the door opening. This will create a step-up at the entrance and will help prevent water flowing inside. See proposed detail in appendix V.

8. Water tight frame details for the circular windows

The circular windows opening into the crypt hall have a raised sill level of the exterior circular frame. The sill level from inside is at least two inches below this exterior sill level. There is also a gap between the wooden frame and the back of the outer circular frame. Thus rain water seeps in from the window sills inside the crypt hall. To rectify this detail it is proposed that a precast cc panel will be inserted from the inside in a manner that an inner intermediary sill level is created at a little raised level than the exterior sill. This will prevent rain water from seeping in through the sills. It is also proposed that the precast cc panel will be used to form a circular frame from inside as well in which circular windows will be installed. See proposed details in appendix VI.

9. Re-painting of interior spaces

The interior space – i.e. the crypt hall has badly damaged paint surfaces. The peeling paint layers indicate that all of these surfaces have been repainted several times. The accumulated layers of paint; especially on the plaster of Paris carvings of the ceiling decorations has resulted in disfiguring the details. The walls and ceiling also have several accumulated layers of paint, which partly contributes to the peeling and chipping. Once the issue of dampness inside this space is dealt with and the surfaces are completely dried, these interior treatments will be undertaken. All painted surfaces will first be cleaned with proper scraping, to the extent that all previous layers of paint are removed and the plaster surface is clearly visible. The surfaces will then be sanded with a coarse grade emery paper. The surface will then be prepared for application of a fresh coat of paint;
prior to which it should be ensured that no chemical treatments were previous applied on these surfaces which are causing the peeling of paint (besides the presence of moisture). Fresh coat of paint will then be applied on the walls and ceiling of crypt area.

10. **Cleaning of marble monument**

The stone surfaces need to be cleaned as they show soiling due to dirt accumulation, bird droppings and black crust formation, especially on horizontal surfaces such as cornices, horizontal planes of the pedestals and platforms, and carving details, etc. In the first stage of cleaning all dry and loose dirt particles will have to be brushed off with hard brush, carefully ensuring that no loose particles of the stone itself are lost in the procedure. Such loose or detached pieces of stone should first be consolidated and repaired only then the general cleaning and washing should proceed. General washing of the entire stone surfaces will have to be done with mild soap and distilled water. Only after this initial cleaning, the more stubbornly adhering dirt patches, such as black crust formations, etc. will be treated. For a detailed, recommended process of stone cleaning refer to **appendix II** of this report. After satisfactory cleaning of all surfaces the polishing of marble should be done and if desired a protective coating may be applied.

11. **Replacement of damaged exterior elements**

The disintegrating, damaged or missing c.c. elements need to be carefully removed and replaced with replicated replacements. Since first hand authentic information is available on the original design of all such elements, replicating these with precision of detail and design will not be a difficult task. The replaced elements must be marked with the year of intervention engraved on each piece them.

12. **Prevention and removal of biological growth**

Presence of moisture is the man cause for biological growth. The main sources of water in the case of CTK Monument are identified earlier. Of these, the remedial measures for door’s thresh-hold and circular windows is already discussed above. The source of water for external damages has been the watering the watering of potted plants placed on the steps or inside the urns/ planters. Although most of these have been removed but a few are still there, and need to be removed. Once the sources of water are tackled with, appropriate measures for cleaning of surfaces soiled by organic growth can be carried out. First attempt at cleaning can be done with simple brushing and scrubbing with dry bristle or soft wire. The surface can also be washed by jetting with high pressure, low-volume water lance to soften the crusts. However, rapid re-colonization is most likely if the source of moisture is not eradicated completely. Use of mild toxic wash can be effective for delaying the reoccurrence.
Macro plant growth can be killed by spraying with an appropriate weed killer. It is important to kill the roots and remove any humus which may encourage future growths. Any gaps or cavities created due to the removal of plant growth should be repaired/ filled with lime mortar (see appendix III).

13. Re-painting of exterior elements

The exterior surfaces and elements including the stair handrails, balustrades, urns/ birdbaths, and other details which are not made of stone will be cleaned by scrapping off all previous layers of paint and after proper preparation of these surfaces and fresh coat of weather shield paint will be applied.

14. Polishing of marble surfaces and monument

All marble surfaces or elements including carvings, sculptures, cladding slabs and flooring tiles will be polished after their appropriate cleaning and required repairs. For polishing of marble see the suggested method in appendix IV. A protective coating may be applied over polished surfaces to control water absorption and discourage dust accumulation.

15. Exterior landscaping

The CTK Monument had grass patches around it in between the areas between the stairs on all sides. These green patches are no longer maintained as their watering had been one of the sources of damages presently seen on the monument. Some residual dried up patches of grass still exist. Additionally some potted plants were also placed on the steps and inside the urns. Only a couple of these are now existing; and that too not in a maintained state. It is proposed that if proper landscaping around the monument is desired it should be a combination of soft and dry landscaping, designed with appropriate water proofing and drainage of run-off water.

16. Long term maintenance program

The approach for remedial and restoration measures decided by the steering committee is to strengthen the monument and implement sufficient measures to rectify the causes of damages. In this regard the present issue of faulty slopes for run-off surface water was identified as one of the primary reasons of water penetration inside the crypt area. A permanent and more lasting remedy would be to insert a water protective layer underneath the marble tiles. But a collective decision was taken against this due to the danger of damage to the original tiles. The suggested approach for treating all external surfaces with water sealants and repair mortars would result in reducing the water penetration to a great degree but its long term effectiveness would be dependent on other issues like resistance of used materials to external climatic factors and the regular maintenance of the monument. It is thus recommended that the management committee of CTK Monument develops a long term maintenance program and ensures that the guidelines developed in it are strictly followed. The following should be incorporated in this maintenance program.
(a) Periodic Checking of Sealant Treatment on all External Surfaces
The chemical sealants and repair mortars used on all external surfaces should be checked after every four to six months for any signs of damage of decay. Their performance against water penetration should also be checked on site after every rain. Any small indications of decay, damage or disintegration should be immediately reported to the managing committee and immediate measures should be taken to repair these damages before they get magnified.

(b) Immediate Wiping of Floor Surfaces after Rains and Wet Cleaning
After every rainfall all surfaces should immediately be wiped clean of any standing water pools. Any wet cleaning undertaken for the monument must be through a properly monitored process ensuring that water is not splashed or jetted with high pressure. Each wet cleaning should terminate at proper drying up of all surfaces. Use of saline/brackish water should be avoided at all costs.

(c) Discouraging/Controlling Birds to Perch
In order to reduce the menace created by the presence of birds on the site, some measures can be taken to control bird population; and also discourage them from settling on to the ledges and horizontal surfaces of the building. A few techniques commonly used internationally include;

- Stretching a synthetic mesh of unobtrusive color across potential roosting sites such as deep ledges, window openings, roof ridges, etc. But these can have an unaesthetic appearance on the building.
- Strips of gel applied on ledges where birds may roost. This provides an insecure footing, discouraging the birds from settling down. But once the gel dries off it can become a nuisance in itself, because it adheres to the surfaces rigidly and could not be easily taken off.
- Low voltage wires, with small electric charge, can be stretches between insulators along the ledges.
- Other known methods are trapping birds and removing them from site, shooting or scaring them away by producing noise. But these methods seem cruel and would be criticize by the bird lovers.

As a long term preventive measure regular cleaning of the areas which are soiled by bird droppings should be made as part of the continuous upkeep routine. This will ensure that the build-up does not happen and surfaces are washed off before the soiling becomes so severe that it would require professional cleaning measures.

The above mentioned remedial measures should follow a logical sequence to ensure optimum results.
APPENDIX II

Cleaning of Stone Surfaces

The stone surfaces of the monument show dirt accumulation as well as black crust formations at various locations. To clean the entire façades, chemical cleaning by the following process is recommended.

Proposed method for cleaning of stone:

Step 1:
• Gently brushing off all loose particles; sand, dust, etc. Mapping of any loose fragments as well as dislodged pieces of stone should also be done at this stage. The particles or pieces of detached stone that are of substantial size should be examined for strength and if found in good state are recommended to be fixed to their original location by grouting and joining techniques.

Step 2:
• Temporary filling or repairing of the open mortar joints and decayed pointing is to be done before starting wet cleaning.

Step 3:
• Gently spray distilled water on the stone surfaces to be cleaned (starting from upper parts). Scrub with sponge or nylon brushes and rinse off the surface with spray of distilled water. Let the masonry dry off. If black patches of dirt or black crust are still observed then clean only these parts with an Ammonium Bicarbonate poultice, in the following way.

Step 4:
• Cleaning of soiling and black crust with ammonium bicarbonate solution. Before deciding upon the concentration of the solution to be used, treatment test samples should be done. The selected sample treatment areas should be characteristic of the deterioration or soiling found on the building. Sample areas should ideally be as inconspicuous as possible. It is recommended to adopt a sequential approach, starting with the least aggressive methods first and gradually increasing the applications until an acceptable level of cleaning is achieved.

• If the biofilm is wet, it should be allowed to dry first. Dried bio-film will be brushed and surface applied with the ammonium bicarbonate poultice.
Preparation and Application of the Poultice:
- Prepare 10% solution of Ammonium Bicarbonate in water.
- Dissolve the particles thoroughly, and sieve the solution through very fine fabric (e.g. nylon stockings).
- Add paper pulp to the solution till it gives a thick paste.
- Brush off and clean the trial surface area.
- Take the pulp in hand and squeeze off extra solution, then throw on the surface and gently spread with fingers.
- Leave the poultice on surface, for a while, checking at each 10 to 15 minutes interval.
- Take off the poultice at a time when the desired level of cleaning is achieved.
- Brush the surface and wash off with water.

It is recommended that the sample cleaning should be started with the least concentration of solution i.e. only 10% with minimum time of application i.e. 15-30 minutes. If the crust does not remove then only the concentration and time is gradually increased. But the concentration of solution should never go beyond 30% as this is the level of saturated solution. If the higher concentration solutions also do not work then a sample with very small percentage (only 5%) of EDTA (Ethylene-diamine-tetra-acetic acid) can be attempted.

Poultices should be prepared; first those with a solution in water of 10% ammonium bicarbonate then gradually increasing in concentration if the 10% solution does not give effective results. 25% ammonium bicarbonate up to 30% saturated solution of Ammonium Bicarbonate.

If the poultice is required to be left for a longer time span then it should be covered with a sheet of polythene and left for a few hours. It is then cleaned by a sponge, dipped in distilled water.

If algae persists in certain spots, these can be treated with biocide treatment. This is done with a solution of 10% benzyl chloride or 2% zefiran in water. But this should be done after the necessary repair works.

Step 5:
Repair work, where deemed necessary should be undertaken after cleaning with poultice and before biocide treatment. The lime mortar used in all repair works must be prepared according to the specifications given in Appendix III.
• Re-pointing and filling of gaps with permanent lime mortar. The mortar is to be applied with metal spatulas, firmly pushed into the gap and further compacted with a hard sponge. The extra mortar on surface should be cleaned with a wet sponge.

• If there are any deeper cracks or fissures these should be filled with mortar using hydraulic lime.

• All horizontal surfaces of windowsills and cornices to be sealed, by covering the whole surface with a layer of lime mortar. Once the surfaces are sealed the water will drip over the edges of these surfaces. These areas should be regularly monitored and repaired whenever required.

**Step 6:**
If salts have penetrated inside the building, they will start to appear on surface in the form of efflorescence once the masonry is dry. These can be cleaned by paper pulp technique. This should be done after the problem of dampness penetration has been dealt with. First the building will be aired and allowed to dry completely. Salt deposits/salt crusts or efflorescence that appear on surface after drying, can be simply brushed off. The remaining salts can be cleaned with paper pulp technique. In this method, blotting paper sheets or paper pulp wetted with distilled water are applied on areas that have crystallized salts. The paper is left to absorb all soluble salts, and then taken off. Repeat the process as many times as required till salt efflorescence does not appear any more.
APPENDIX III:
Lime Mortar Treatments

Lime mortar treatments are to be done for damaged or decayed mortar joints, as well as for re-pointing and filling of gaps in masonry. It can also be applied as a protective layer on horizontal surfaces, for prevention against further deterioration. Lime mortar of specified composition should be used for this purpose.

It is observed that previous treatments of lime mortar are done along the junction of vertical and horizontal surfaces. The application of this repair mortar seems somewhat clumsy. The strength and porosity of these repair mortars need to be checked before a decision for their removal could be taken. If too porous and damaged/ cracked in most areas then it would be recommended to remove it from all places with gentle chiseling, hammering or scrapping. After a thorough cleaning of the loose mortar, all open joints and gaps in joints should be re-pointed with lime mortar. Loose stone fragments can also be consolidated by grouting with lime mortar.

**Preparation of lime mortar for repair:** The lime mortar to be used for repair works should have higher porosity and water absorption, whereas less density and strength than that of stone. According to a research done on repair plasters of historic buildings in Karachi by Arch. Yasmin Cheema, it was found that these were lime plasters of a high water absorption capacity and porosity, and low density. Their binder-aggregate ratio was also different from the ones normally used. Generally, binder and aggregate ratio in mortar is 1:2 or 1:3. Whereas, laboratory tests of old plaster samples of British period repair lime mortar, show lime (binder): sand (aggregate) ratio of 3:1. This lime mortar has better cohesive properties, thus recommended for used in all repair works.

The lime mortar prepared for repair of joints, filling of gaps, and protective coating of horizontal surfaces should either have a ratio of 3:1 (lime : sand) or it should be 1:3 (lime : aggregate) in which two parts of the aggregate should be of crushed limestone of the same type as used in the construction of the building. This mortar should have higher porosity and water absorption capacity, whereas less density and strength, than that of stone used in the building.

In addition to this the mortar samples collected form the site should also be sent for an analysis of their composition and properties and the repair mortar prepared in accordance to the findings.
APPENDIX IV
Polishing of Marble Surfaces

• File the surface with Silicon carbide paper – starting with rougher paper and then gradually with finer paper.
• Finally the surface is polished with cloth and some metal oxide like tin-oxide (better for most stones) or lead oxide. (Jewelers use similar method for polishing stone).
  • For building stone mechanical disks are used for polishing stone slabs.
  • Starting first with 180 paper (wet with water); then 250, 320, 500, and end with 600
• For very rough stone surface smooth it first with machine and then finish with finer grade paper.
APPENDIX V
Detail of Threshold at the Two Entrance Doors
APPENDIX VI
Detail of Circular Windows Rectification