



PRESERVATION OF TOMB OF JAN BABA, WHS MAKLI

1ST EXPERTS' COMMITTEE MEETING

Folio XI – Consultants' Assessments





PRESERVATION OF TOMB OF JAN BABA, WHS MAKLI

STRUCTURAL ASSESSMENT

By

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STRUCTURAL ISSUES IN HISTORIC STONE MASONRY

- **Chipping of Stone Masonry**
- **Blistering of Stone Masonry**
- **Crumbling of Stone Masonry**
- **Detachment of Stone Masonry**
- **Efflorescence and Sub-florescence in Masonry**
- **Pitting in Masonry**
- **Delamination of Stone Masonry**
- **Erosion of Masonry**
- **Cracks in Stone Masonry**

SOLUTION FOR STRUCTURAL ISSUES IN TOMB OF JAN BABA

PLATFORM

The platform is to be repaired for broken corners, edges inserting/fixing stones. The joints are to be filled with mortar. The slopes are to be maintained so as to push water away from building.

EXTERNAL WALLS

The external walls are to be checked for alignment for any progressive bulging or movement. In case of movement turn buckles with wire loops may be used after proper investigation.

SOLUTION FOR STRUCTURAL ISSUES IN TOMB OF JAN BABA

DOMES

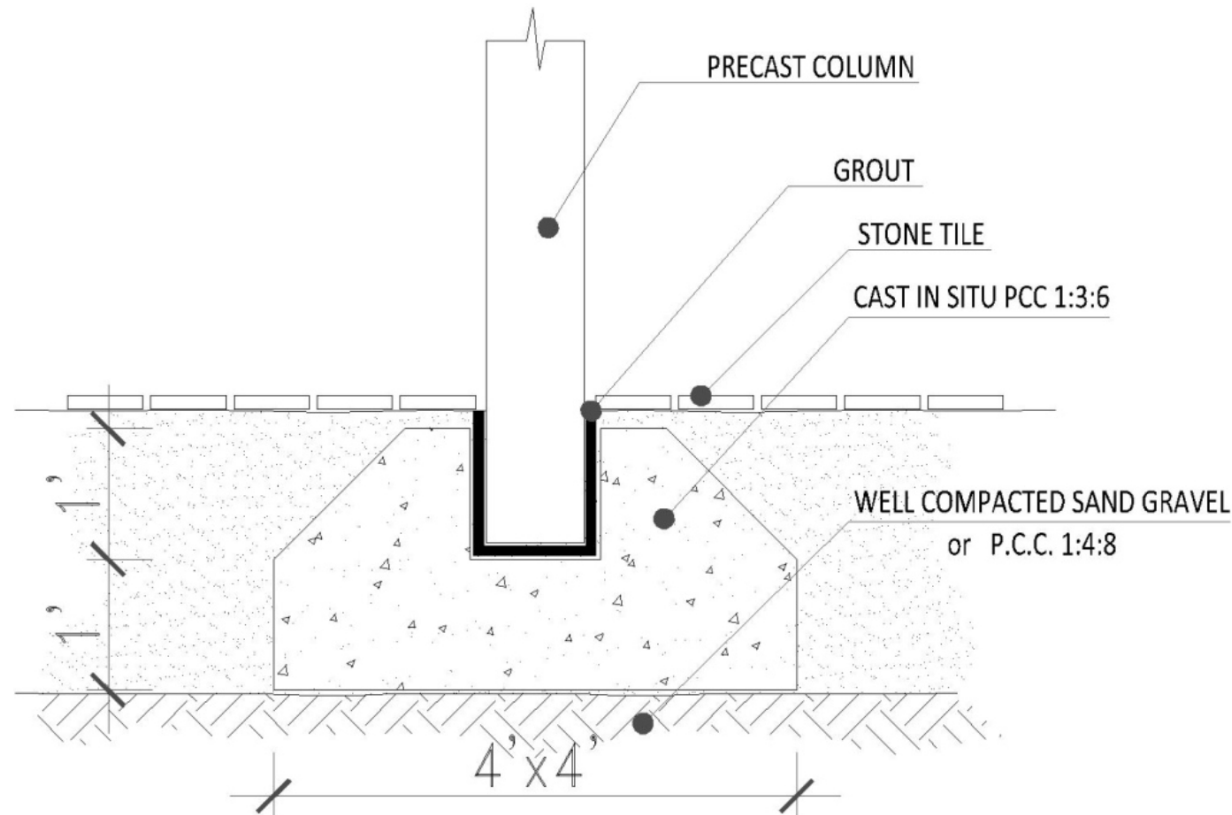
Out of three, two domes are completely damaged which as a temporary solution need to be covered immediately by using Fiber glass or some indigenous material to prevent damaging of floor and graves from rain water penetrating through these openings. However these domes should be reconstructed as per original fabric and shape as final solution.

The third dome needs to be temporarily supported to stabilize and stop from further deterioration and cracks to be repaired as per original architectural conservation requirement.

SOLUTION FOR STRUCTURAL ISSUES IN TOMB OF JAN BABA

TILTS IN COLUMNS

The foundation of columns with visible tilts are to be treated as per below sketch. The stone masonry of columns is to be reassembled in proper alignment. Similarly the side chambers are to be reassembled in correct alignment.



TYPICAL DETAIL FOR PRECAST FOUNDATION SECTION

SOLUTION FOR STRUCTURAL ISSUES IN TOMB OF JAN BABA

POOR SURFACE DRAINAGE

The water ingress from near by pond to be prevented immediately by constructing a barrier both surface and sub surface. The surface drainage to be evaluated and redesigned for effectiveness to prevent further deterioration of floor and tomb structure.

For all Makli structures instrumentation and control system must be in place. Seismic up gradation may be required as per latest codes local design earthquakes.

STRUCTURAL SAFETY ZONING OF TOMB

Zone-A:

It is non-historic part to be removed whenever possible but keeping safety on top priority with zero damage to adjoining historic parts.

Zone-B:

This is relatively safe zone for historic conservation works if to be carried out. Minimum danger of global failure but local failure may occur hence one can move inside with precautions and care.

Zone-C:

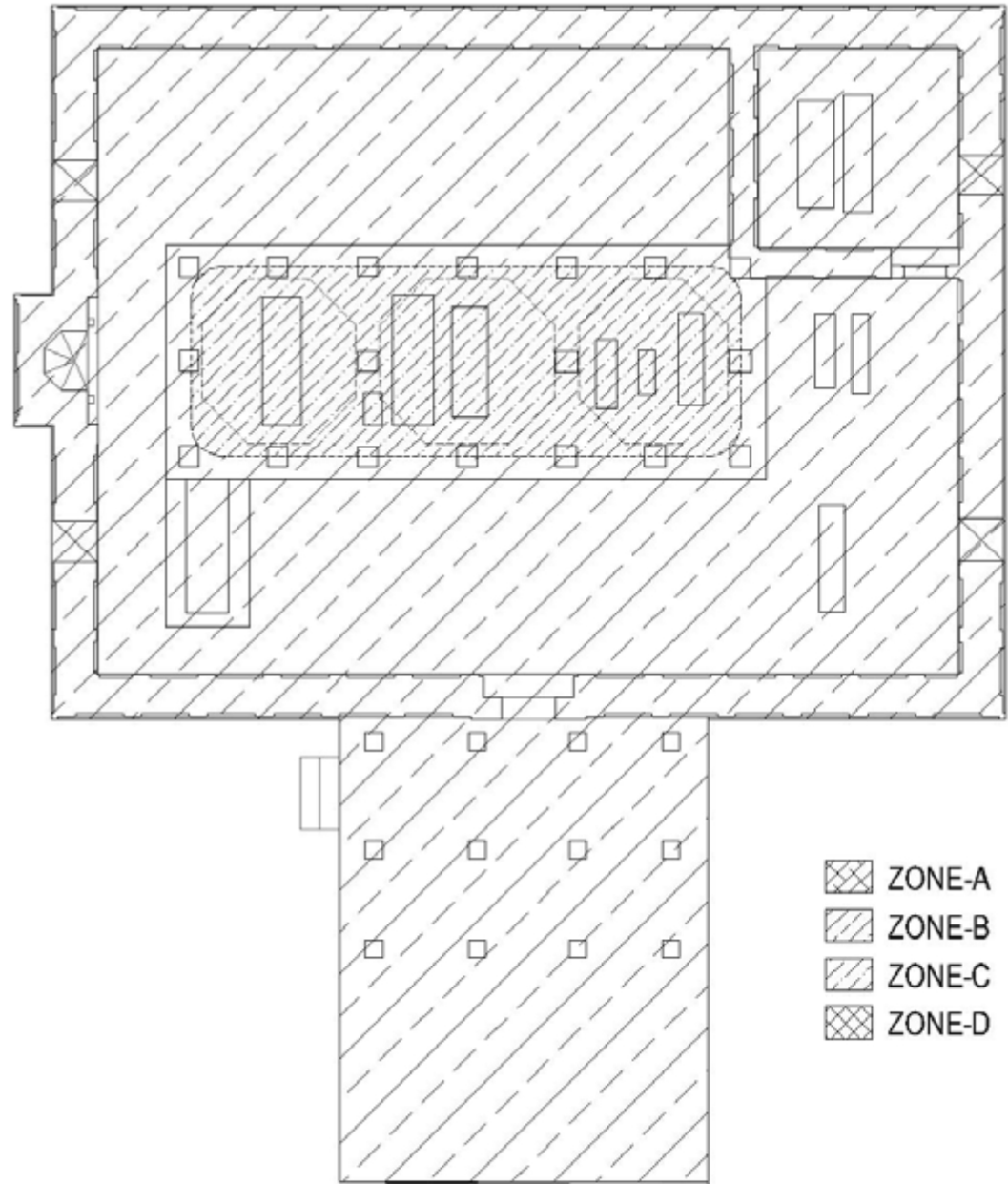
Dangerous Zone but movement for conservation works is possible with safety & care.

Zone-D:

This is the zone which is technically collapsed because tilt is much more than permissible limits and separated parts at top levels may fall down and most dangerous to the people and property inside and around. This is no-go area and any sort of activity is not permitted inside or around.

CONCLUSION AND RECOMMENDATIONS

The Tomb of Jan Baba comes under Zone B except domes which come under zone C. The domes look critical and need to be supported immediately; as a temporary solution the opening needs to be covered. These domes to be reconstructed as per original fabric and materials as final solution.



CONCLUSION AND RECOMMENDATIONS

The apparent condition of Tomb columns shows significant tilts and signs of settlement. The columns close to grave are most vulnerable. The foundation of columns are to be treated and if the problem persists after treatment of foundations in future then diagonal strutting or some sort of tying arrangement may be required.

The water ingress from near by pond to be prevented immediately by constructing a barrier both surface and sub surface.

The surface drainage to be evaluated and redesigned for effectiveness to prevent further deterioration of floor and tomb structure.

The Tomb of Jan Baba may require foundation grouting for soil stabilization and is to be decided after precise and relevant Geotechnical studies incase.



PRESERVATION OF TOMB OF JAN BABA, WHS MAKLI

GEOTECHNICAL ASSESSMENT

by

Consolidated Engineering Services



PROGRAM OF INVESTIGATIONS

A total of four boreholes were drilled to the depth of 50ft at specified locations.

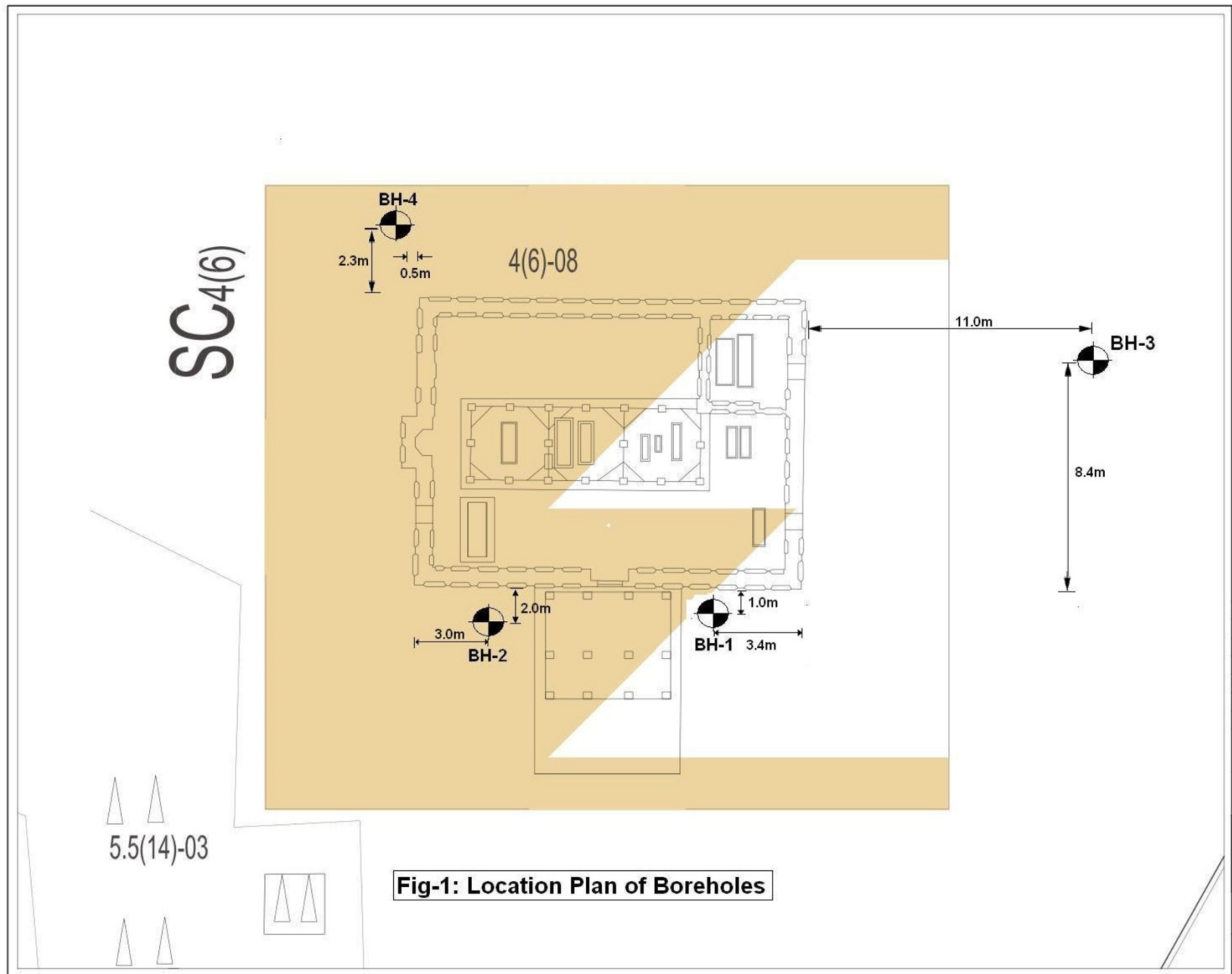
Rotary drilling method was used to advance the borehole to the required depths. Rock was encountered from surface level and overburden was not encountered, therefore, Standard Penetration Tests (SPT) were not conducted. Core samples were collected from rock formations.

Representative samples of subsoil materials were preserved for further testing.

A program of laboratory tests was conducted and selected representative samples were tested to determine physical and engineering characteristics of various subsoil materials encountered at the site.

The tests were conducted in accordance with Standard Procedures as given in relevant ASTM/BS standards.

PROGRAM OF INVESTIGATIONS



RESULTS OF INVESTIGATION

SITE AREA

The Tomb is situated on relatively flat area. The subgrade around the Tomb is essentially highly weathered LIMESTONE. The weathering has caused disintegration of LIMESTONE into gravel form which can be seen strewn on surface level.

Apparently, the Tomb has been founded at shallow depth. A Stone Block platform (about 2ft high) covers the area around the Tomb.

RESULTS OF INVESTIGATION

STRATIGRAPHY

The subsoil materials as encountered at the site have been described in detail in Borehole Logs and summarized hereunder:

- **Layer - I:** 1st layer consists of medium hard LIMESTONE which encountered from existing ground level and extended up to 30ft depth in BH-1&BH-2, up to 25ft depth in BH-3 and up to 35ft depth in BH-4.
- **Layer - II:** 2nd layer consists of medium hard CLAYSTONE which extended up to 40ft depth in BH-1&BH-2 and up to 45ft depth in BH-3 followed by LIMESTONE extending to 50 ft depth of BH-2 & BH-3. SHALE was encountered from 45 to 50 ft depth in BH-1 and 35 to 50 ft in BH-4.

GROUND WATER LEVEL

Ground water was not encountered at the time of investigation.

CONCLUSIONS

- **The actual depth of the foundation of the Tomb could not be ascertained since any excavation to expose the foundation could have been dangerous for the structure. However, it is envisaged that the foundations of the Tomb are at shallow depth of the order of 3-4 ft below natural sub-grade which essentially consists of LIMESTONE as described in borehole logs.**
- **It is envisaged that the Tomb structure is supported on Strip Foundation on the periphery of the Tomb structure.**
- **Based on Borehole Investigation and Laboratory Test data, the Allowable Bearing Capacity of 2tons/sqft may be considered for the foundation system of the Tomb. The adequacy of the foundation system of the Tomb can be assessed only when foundation size is determined.**

RECOMMENDATIONS

- **Based on borehole investigation data following Seismic Parameters (UBC-1997) may be considered for the foundations:**

Seismic Zone	Zone Factor	Soil Profile Type	Seismic Coefficient	
			“C _a ”	“C _v ”
2B	0.2	S _c	0.24	0.32

- **Allowable Bearing Capacity of 2tons/sqft may be considered for analysis of existing foundation system.**

RECOMMENDATIONS

- **The Allowable Bearing Capacity value corresponds to maximum one inch settlement. The settlement considered is instantaneous and long term settlement is not involved. However, the actual settlement may be much less due to the reason that foundations are supported on LIMESTONE Rock.**
- **Modulus of Elasticity and Modulus of Subgrade Reaction of subgrade material at foundation level is recommended as follows:**

Modulus of Subgrade Reaction = 288 lb/cu in (80,000 kN/m³)

Modulus of Elasticity = 50 tons/sqft (5,000 Mpa)