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Delhi Domes in Transition

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ABSTRACT: This paper explores the transition of accommodating new design considerations within existing paradigms of structures and construction during historic times, and attempts to cover this aspect for dome construction in during the Lodi Period (1451 – 1526 CE) in Sultanate Delhi.

1 INTRODUCTION

The design principles and architectural considerations for any structure are never rigid and influenced by a number of factors including socio-cultural dynamics and individual aesthetic preferences. History is filled with instances where every new political dynasty has tried to introduce new features to existing architectural vocabulary, from subtle features to dramatic changes, either to assert their power or leave behind architectural memorabilia as a reminder of that particular period to future generations.

It has been the prerogative of construction techniques to evolve themselves to meet these new design challenges. The concept of arches and domes was introduced in Delhi in late 12th Century CE, as symbols of new Muslim ruler ship and authority over local people. However, construction systems known to local masons were trabeate and corbelled systems, and were applied for construction of arches and domes in the buildings of early Islamic period in Delhi like Quwwat-ul-Islam mosque at Qutub complex and Sultan Ghari complex, see Fig 1.

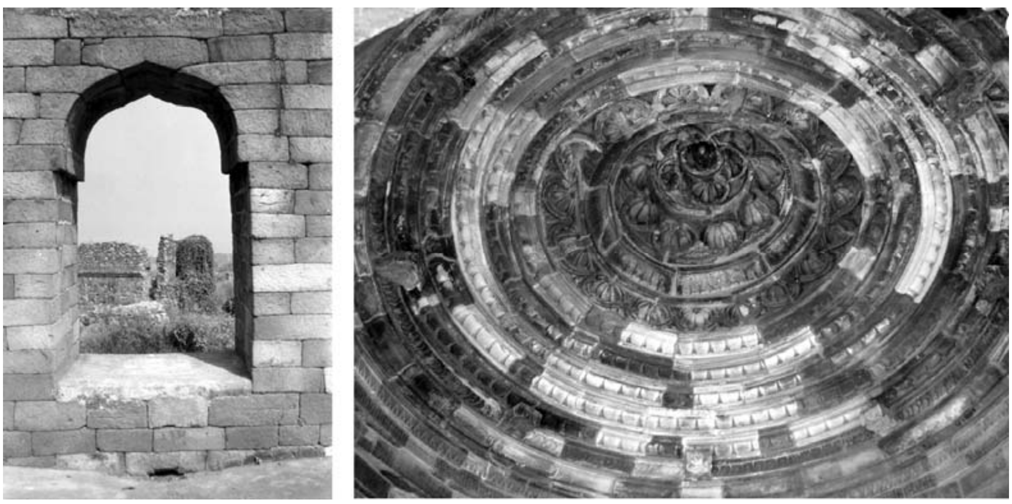

Figure 1 : Arch and dome construction in early Islamic Delhi (Author, 2003)

Symbolic significance took precedence over structural authenticity and new solutions emerged that constitute architectural evolution in true sense of the word.

However, there are limits to such solutions as is evident in the first recorded attempt to apply this solution for dome construction across a larger span in Tomb of Sultan Iltutmish, built in 1235 CE, where the corbelled dome collapsed under its own weight.

Such phases are the most intriguing periods in historic building development. And such interfaces occur all the time because architecture is ever evolving and structure has to continually evolve too to meet the demands of new design.

But, design processes also compromise when structural endurance is stretched to its maximum. Meanwhile, there is a constant search for new technical solutions to give shape to new ideas of design. And solutions are found either through continuous evolution of indigenous technology over a long period of time or through adoption of new techniques from other social contexts with developed systems.

In Delhi, true dome construction was made possible only with the advent of true arcuate principles of construction from western Asia in 13th Century CE and the first datable true dome is at Alai Darwaza, built in 1311 CE. Refer Fig. 3.

This paper explores select aspects of a similar interface between design and structure for dome construction during the Lodi period (1451 – 1526 CE) in Delhi. It emanates from the author's Masters Thesis and limits to examples of Islamic tomb architecture. However, it is understood that similar interface may apply to domes of other building typologies as well.

2 TOMB ARCHITECTURE IN DELHI DURING LODI PERIOD (1451 – 1526 CE): AN OVERVIEW

Most of the building activity during the Lodi period is funerary and evident in the "countless tombs and mausolea raised in and around Delhi." (Davies 1989)

Brown (1981 Re.) writes that "the more important of these tomb-buildings took two separate forms… On the one hand, there was a type designed on an octagonal plan, surrounded by an arched colonnade or verandah with a projecting eave and one storey in height. On the other, there was another type, square in plan, having no verandah, and the exterior being two, and sometimes three stories in height… In both instances the building was surmounted by a dome, with not infrequently a range of pillared kiosks rising above the parapet, one over each side of the octagonal kind, and one at each corner of the square variety.", see Figs. 2 and 3.

Figure 2 : Tomb of Sikander Lodi, New Delhi (Author, 2005)

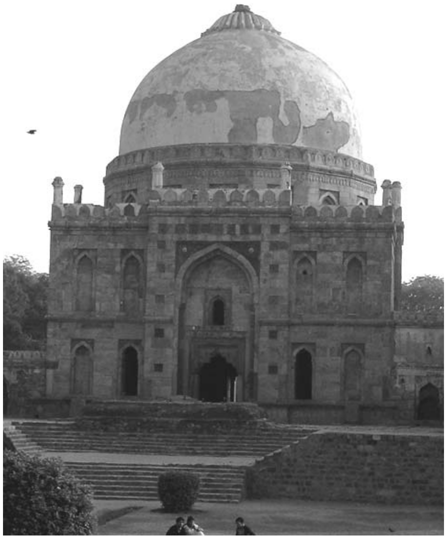

Figure 3 : Bada Gumbad, New Delhi (Author, 2005)

Other common features of Lodi tombs:

- Arcuate constructions in stone masonry with load transfer through the mass of the building
- Elevated ground for location, either through the utilization of a natural ridge or by creating artificial earth mounds – a feature adopted from earlier Sayyid era (1414 – 1451 CE) tombs
- Lofty domes with drums
- Surface finishes used: Dressed quartzite stone with sandstone ornamentation or Lime plaster
- Ornamentation:
    a. Tile work in select tombs – ceramic and stone tiling
    b. Merlons in parapet, battlements and *kangooras*

3 DOMES IN LODI TOMBS

3.1 Information available in the public domain:

All literary sources agree unanimously that the domes built during the Lodi period are loftier than previous examples, see Fig. 4, so much so that the square tomb prototype of the Lodi tomb is commonly referred to as 'Gumbad' or the Dome. E.g. the Tomb of Kale Khan is called Kale Khan ka Gumbad. It is hazarded that this was to enhance the visual proportions of the dome, which seemed stunted from ground.

Figure 4 : Dome of the Tomb of Feroz Tughlaq, built in 1388 CE vis-à-vis dome of Kale Khan ka Gumbad, a Lodi era tomb built in 1481 CE (Author, 2005)

Written references vis-à-vis structural aspects of Lodi domes relate only to the Tomb of Sikander Lodi, built in 1517 CE. Refer Figure 4. Both Brown (1981 Re.) and Davies (1989) believe the dome of this tomb to be composed of an inner and outer shell of masonry with a space between the two, referring to it as the first application of a double dome in Indian architecture. However, the only basis of this claim is the presence of an opening in the dome, visible from outside but not from inside. Refer Fig. 2. The available documentation does not reflect this. Refer Fig. 5.

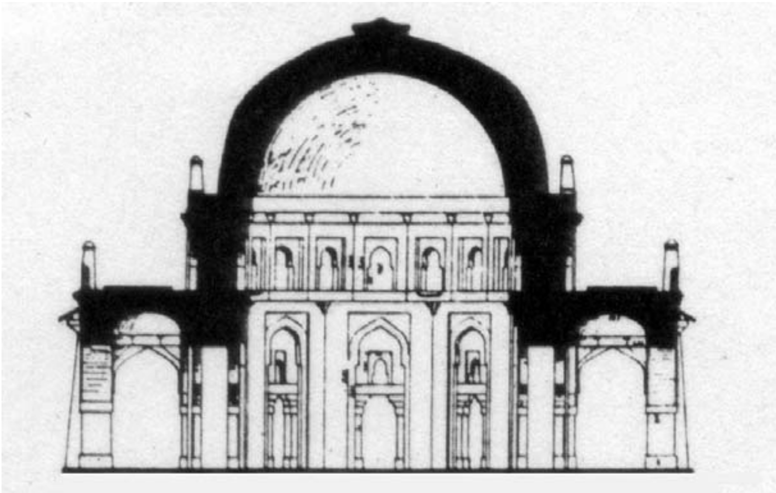

Figure 5 : Section of the Tomb of Sikander Lodi (Tadgell, 1990)

It is noticed that all the information from secondary sources is from a historian‘s point of view and centres upon physical description of buildings and building elements based upon visual surveys. There is little information on technical aspects. Also, the nature of available building documentation is questionable because the domes drawn so are hemispherical in shape and do not reflect the loftiness of Lodi tombs, see Figs. 5 and 6.

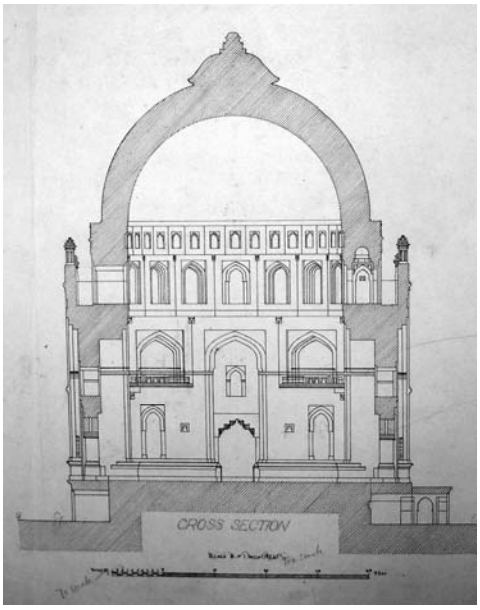

Figure 6 : Section of Bada Gumbad (ASI archives, undated) – an inaccurate drawing that shows hemispherical profile of the dome contrary to ground realities

Therefore, primary studies and analyses are necessary to enable any structural understanding of these monuments and to understand correlation between design and structures.

3.2 Crucial observation:

Primary study of these structures reveals a common feature hitherto unrecorded – an abrupt change in curvature in the insides of the dome, prominent to the naked eye, see Fig. 7. It further shatters the myth of hemispherical inner profile of Lodi domes.

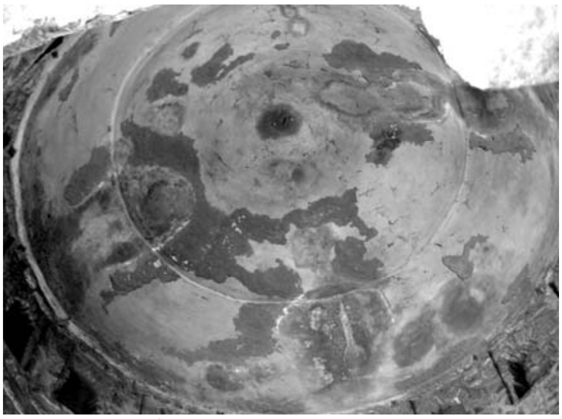

Figure 7 : Ceiling of Bara Khamba, Green Park (Author, 2005)

3.3 Primary case study: Kale Khan ka Gumbad, 1481 CE

A primary building documentation and study of this Lodi tomb reveals the true lofty proportions of the dome with a non-uniform thickness that increases in consonance with the sudden change in curvature of the external profile, see Fig. 8.

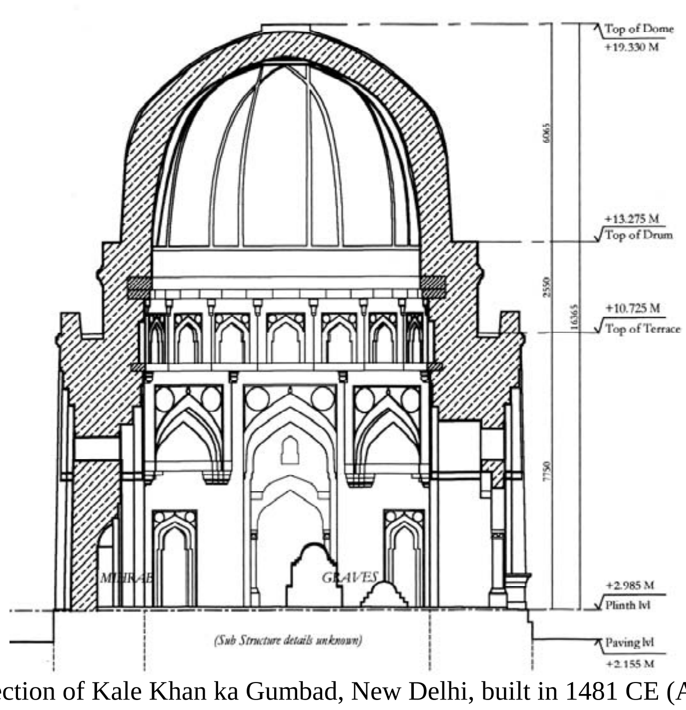

Figure 8 : Section of Kale Khan ka Gumbad, New Delhi, built in 1481 CE (Author, 2005)

While construction details of the dome are still unknown, a basic analysis of the dome based upon the graphical method purported in Heymann (1982) implies that the dome does not have a very high factor of safety and its average thickness is nominal, see Fig. 9. The sudden increase in the mass of the dome occurs at the highlighted location where the line of thrust needs more masonry mass to be accommodated within the section of the dome.

Concurrently, the point of change in internal curvature of the dome is located at the base of this critical mass.

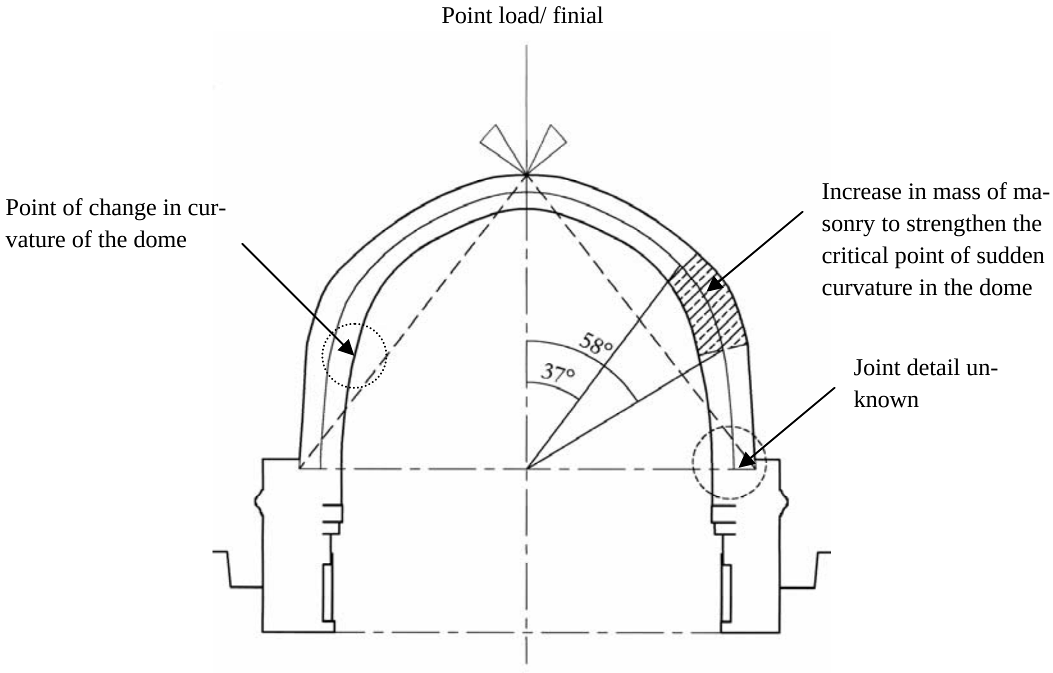

Figure 9 : Analysis of dome at Kale Khan ka Gumbad

4 CONCLUSIONS

The aforementioned case study exhibits another interface between architecture, structure and construction since loftiness of the dome is an architectural requirement to maintain visual proportions, and the differing curvature of the internal profile a part of the structural solution to maintain the line of thrust within the masonry mass, thus, enabling structural stability.

It is more crucial to understand that such interfaces have occurred constantly in our built histroy. However, the existing level of information is very poor and the will to overcome it poorer still. Structural understanding of historic constructions remains an unchartered territory in India.

Built heritage in India primarily evokes a romanticized vision in popular memory as grand representatives of our rich cultural past. Percolating into the technical domain, such a perception has resulted in an overall approach to heritage protection, maintenance and management, which focuses on maintaining the visual grandeur of built heritage, achieved through preservation of the facades. Any information set deeper inside than the facia is generally ignored. The result is public neglect and lack of comprehension towards less grand buildings as built heritage.

A standing monument cannot be opened up to study its construction details. But the ones that do offer a possibility, either in the way of a partially collapsed building or fallen plaster or any other way, are either demolished due to public neglect, or ‘maintained’ by responsible agencies through means like reconstruction and replastering, to maintain the look of the monuments. Besides hampering the opportunity to fill gaps in our knowledge of historic technology, most of them result in tampering and altering of historic evidence, see Fig. 10.

Figure 10 : Bara Khamba, Nizamuddin – Replastering of an arch has undermined its original proportions (Author, 2005)

This further reflects upon academic and professional domains of architecture and engineering, where the professionals are oriented and trained towards use of present day technology incorporating cement, concrete and steel. This understandably is very dissimilar to historic construction, structural systems, construction details and materials used. In effect, a modern day professional is not very competent to undertake authentic structural interventions in historic buildings in India.

While trained conservation professionals try to do their best, they usually lack engineering basics to understand the structures comprehensively and therefore, follow certain thumb rules for plausible causes to structural problems, sometimes miscalculating the right cause and suggesting inappropriate conservation remedies. A lot of their studies are based on available literature and architectural records of the past, which as mentioned above, are insufficient for structural studies.

Most lamentable is the lack of serious efforts to undertake accurate documentation of historic structures especially their difficult-to-access-and-measure parts like domes, where reality substituted with mythical standards for convenience.

It is extremely important for the professional sector to look beyond the existing levels of information and discover the built heritage anew, for it has vast reserves of untapped information that can greatly benefit the academic realm as well.

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