

# Historical survey on Asian Dome Structures

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**Abstract** - Domes are Architectural structural elements characteristics for ecclesiastical and secular monumental Buildings like churches, Capital halls of city, and mosque. In the scope of Building façade Architectural style classification, the current paper address the some largest architectural style classification of interesting façade domes, which bears the signature of each architectural styles, here some of them are discussed considering Asian domes with technical features and their size, area of construction, year of built and the constructor of the great monument

**Key Words:** Dome, Monumental, façade, ring beam, pendentive, softest

## 1. INTRODUCTION

Dome is a self supporting structural element of architecture that resembles the hollow upper half of a sphere, in this paper tries to list large domes in Asia as well in World. While in Asia there are many Dome structures exists, in this study have considered with refers to material of construction, ancient and large one.

In Asia there are nine largest domes which were constructed from 2<sup>nd</sup> century 150 to 2013- Present. As time moves forward the method and techniques of construction got changed. At the first time, our elders were dealing with masonry and lime concrete. Now it is practiced with Steel and Reinforced concrete structure. As I seen all domes are with high rise, Kept average Rise to span ratio of 1/3 to 1/4 which gives high rise and lowers the stress induced in the lower ring beam.

## 2. METHODS OF CONSTRUCTION

I) One of the ancient dome structure erected in 1302-1312, located in Soltaniyeh, Iran. This was traditionally named as 'Dome of Soltaniyeh' this is a kind of Double-shell dome in Iran. Which is constructed using bricks, this is the third largest dome in the world after the domes of Florence Cathedral and Hagia Sophia. This dome is created spectacularly with thin skin at top and thick at bottom. It is just to lower the stress due to dead load on the top and reduce the bucking failure due to Heavy dead load.<sup>[4]</sup>



Fig-1Dome of Soltaniyey

II) The largest dome in India is Gol Gumbaz located in Bijapur, Karnataka Builder of this Spectacular dome is Sultanate of Bijapur. It was constructed in 1626 to 1656. The designer of this structure is Gopal Ji and Architecture Yaqut of Dabul. Dedicated to Mohammed Adil shah As the name of this structure suggests it is a Circular dome constructed with Dark gray Basalt. <sup>[1]</sup>

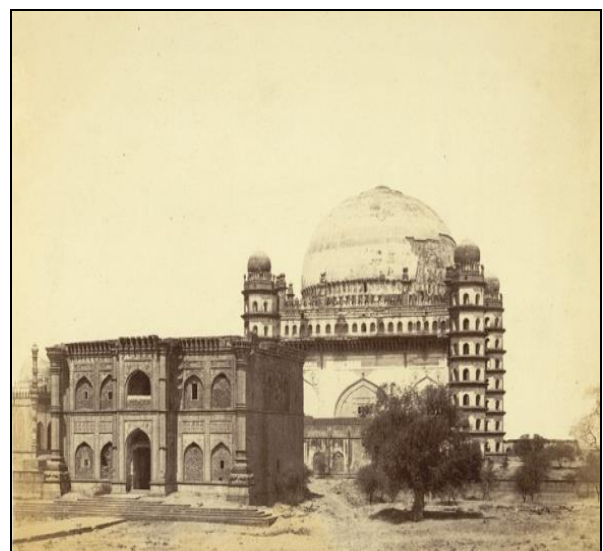
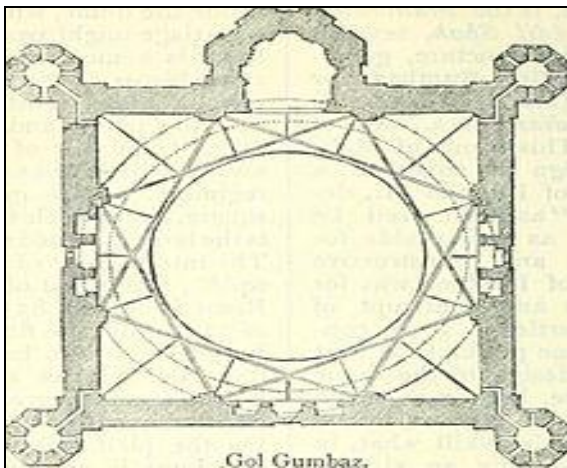
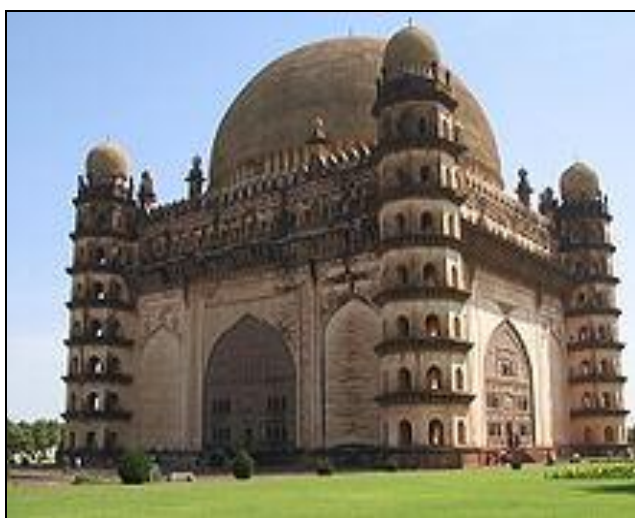


Fig-2 Gol Gumbaz



**Fig-3** Plan of Gol Gumbaz

The structure is composed of a cube, 47.5 meters (156 ft) on each side, capped by a dome 44 m (144 ft) in external diameter. With height of 51 meters, eight intersecting arches created by two rotated squares that create interlocking pendentive support the dome. At each of the four corners of the cube, is a dome-capped octagonal tower seven stories high with a staircase inside. The upper floor of each opens on to a round gallery which surrounds the dome. Inside the mausoleum hall, is a square podium with steps on each side. In the middle of the podium, a cenotaph slab on the ground marks the actual grave below, "the only instance of this practice" in the architecture of the Adil Shahi Dynasty. In the middle of the north side, "a large semi-octagonal bay" protrudes out. With an area of 1,700 m<sup>2</sup> (18,000 sq ft), the mausoleum has one of the biggest single chamber spaces in the world. Running around the inside of the dome is the "Whispering Gallery" where even the softest sound can be heard on the other side of the mausoleum due to the acoustics of the space.<sup>[1]</sup>



**Fig-2** External view of Gol Gumbaz

III) Novosibirsk Opera & Ballet Theatre is another dome structure located at the centre of Novosibirsk at Lenin square.

It is the most important theatres in Novosibirsk. This building was completed in February 1944 and it got name as largest dome theatre in Russia. This is larger than the Bolshoi Theatre in Moscow. And at the time when it was renovated in 2005 with computerized Stage equipment it became most technically advanced in Russia. Total area of the Building is 11,837 m<sup>2</sup> (127,410 sq ft) & volume is 294,340m<sup>3</sup> (10,395,000 Cu ft)



**Fig-4** Siberian Coliseum

This theater is often called as "Siberian Coliseum" Because of its size and beauty. This auditorium has capacity of more than 1790 spectators. & it upper gallery is decorated with copies of antique Greek statues.

The principal construction of the theatre building is the big dome, which is 60 meters (200 ft) wide and 35 meters (115 ft) high. The dome is a unique construction that supports itself without girders or columns. The ratio of its thickness (an average of 8 cm (3.1 in) to its radius is less than that of a chicken's egg. In front of the dome there is a large foyer, while behind it there is a 30-metre (98 ft) deep stage with bars rising up to 30 meters (98 ft) above.



**Fig-5** Theatre with Dome visible



**IV)** Phsar Thom Thmei It is The Central Market at Phnom Penh, Cambodia The name of this Dome is Phsar Thom Thmei and it is a large market with 45m diameter, it was constructed in 1937 in the shape of a dome, with four arms branching out into vast hallways with countless stalls of goods. It is built with reinforced concrete by builder called Jean Desbosis & Wladimir Kandaourooff and it held a record of largest dome in Asia from 1937 to 1960



**Fig-6** Psah Thom Thmey market Arial view

A brief history of this structure is this market area was a lake that received runoff during rainy season, then the lake was drained and construction began in 1937. During the Franco-Thai war the market was bombed heavily by Thai aircraft, causing heavy damage, and it had to be temporarily closed. After the end of World War II the market was rebuilt in the modern style.



**Fig-7** The Market interior

**V)** Araneta Coliseum is another largest dome in Asia after the Phsar Thom Thmei. Located at Quezon City, Philippines. formally known as smart Araneta Coliseum. This is an indoor multi-purpose sport arena that is part of the Araneta Center in the Cubao area of Quezon city, Philippines. It is one of the largest indoor arenas in Asia, and it is also one of the largest clear span domes in the world. The dome measures approximately 108.0 meters and making it the largest dome in Asia from its opening in 1960 until 2001 when it was surpassed by the Oita Stadium in Japan with a dome measuring 274.0 meters<sup>[2]</sup>



**Fig-8** Araneta Coliseum

The Smart Araneta Coliseum is mostly used for sports such as basketball. It is a main venue of the Philippine Basketball Association<sup>[3]</sup> and for the basketball games of the National Collegiate Athletic Association and the University Athletic Association of the Philippines. The Big Dome is also used for boxing, cockfighting, local and international concerts, circuses, religious gatherings, beauty pageants and more. <sup>[2]</sup>

**VI)** Ōita Stadium has a retractable dome roof with roof system driven by a wire traction system with 210 m in Diameter. Which has a building area of 51830 m<sup>2</sup> and total floor area of 92882 m<sup>2</sup> and this is dome constructed with steel. And it functional for sports mainly for football. This is located in Oita, Japan. The architect of this structure is Kisho Kurokawa. And the capacity of the stadium is about 40000 seats. Which is opened from 2001 & The stadium has been announced as one of the venues for 2019 Rugby World Cup which will be the first Rugby World Cup to be held in Asia. <sup>[3]</sup>



**Fig-9** Ōita Stadium, Big Eye

**VII)** National stadium Singapur  
The stadium features a domed roof structure with a retractable roof and configurable seating on the lowest

tier to make it the only stadium in the world that is custom designed to host football

The National Stadium currently holds the record of the largest dome structure in the world. The retractable roof itself will take an approximate 25 minutes to open or close. The roof is made out of a lightweight material called ETFE, which is weather-resistant and blocks the sun's heat giving shade and protecting spectators from the hot and humid Singapore weather during the day and potential torrential rain at any point of time. At night, the retractable roof doubles as a giant projector screen on both sides



**Fig-10** National Stadium, Singapore

Construction work for the sports hub started in 2010 due to the delays caused by the 2008 financial crisis and soaring construction costs. By September 2011, the piling and the foundation of the stadium was completed and construction on the steelworks of the stadium fixed roof started. On July 2013, the installation of the stadium final primary steel 'runway truss' for the roof was completed marking the completion of the steelworks on the National Stadium's fixed roof in preparation for installation of the retractable roof. The stadium was set to be completed in April 2014, however, In February 2014, Sports Hub CEO Philippe Collin Delavaud announced that the National Stadium's completion was pushed back to June 2014. [3]

### 3. CONCLUSIONS

1. From ancient the domes are being used commercially
2. Dark gray Basalt materials are used for construction from ancient time
3. The largest dome we can construct by steel for example, National Stadium, Singapur
4. As bigger the dome, the material and construction methods are being changed
5. Domes are constructed because of their capacity of attendances and Aesthetical view

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