

Date: 08 September 2020

## **Taj Mahal Central Dome is "NOT" Asymmetrical**

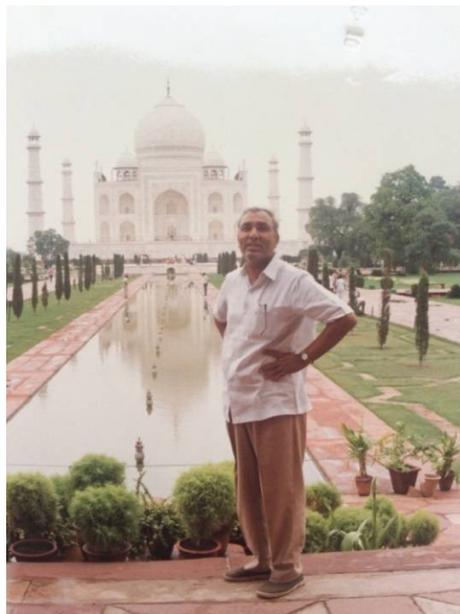
*- Dr.Ram Bajaj (Structural Engineer)*

**If the dimension of the central dome of Taj Mahal is taken & calculated wrong – then everything, in the proof of the Central Dome being Asymmetrical is wrong. The central dome of Taj Mahal is 100% symmetrical.**



**ताजमहल के मुख्य गुमंद (Central Dome) की गोलाई की बनावट में बहुत बड़ा फर्क-मुगल सम्राट शांजहां से इतनी बड़ी चूक हो ही नहीं सकती।**

*-डॉ.राम बजाज (Structural Engineer)*



Dr.Ram Bajaj (Structural Engineer)



Figure 1. Photograph of the central dome of the Taj Mahal showing the supporting drum.

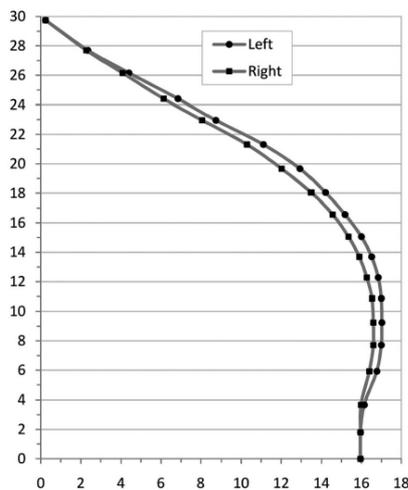


Figure 2. Measurements of the central dome of the Taj. The radius of outer dome (m) is plotted against various height (m) from the top of drum.

The Taj is renowned for its bilateral symmetry. The central structure, however, seems to us to have two imperfections. The first is relatively minor: in some of the photographs, the finial over the central dome is tilted from the vertical axis by about 3° (angle as measured at the bottom of the dome; smaller if measured at ground level). The finial is not original<sup>7</sup>. The tilt could have occurred when the bronze replica was installed in the early 19th century, or during a subsequent restoration.

Table 1. Offset (m) as a percent of the local outer diameter (m) of the central dome

Height (m)	Diameter	Offset	% Offset
29.75	0.48	0	0
27.70	4.64	0.08	1.66
26.16	8.45	0.32	3.83
24.41	12.97	0.72	5.52
22.96	16.79	0.67	3.99
21.31	21.40	0.82	3.85
19.67	24.95	0.92	3.67
18.05	27.69	0.71	2.56
16.57	29.74	0.62	2.07
15.07	31.35	0.65	2.06
13.70	32.41	0.62	1.92
12.28	33.12	0.58	1.74
10.88	33.53	0.47	1.40
9.24	33.62	0.42	1.26
7.72	33.60	0.40	1.19
5.93	33.18	0.38	1.14
3.66	32.13	0.16	0.50
1.79	31.91	0	0
0	31.91	0	0

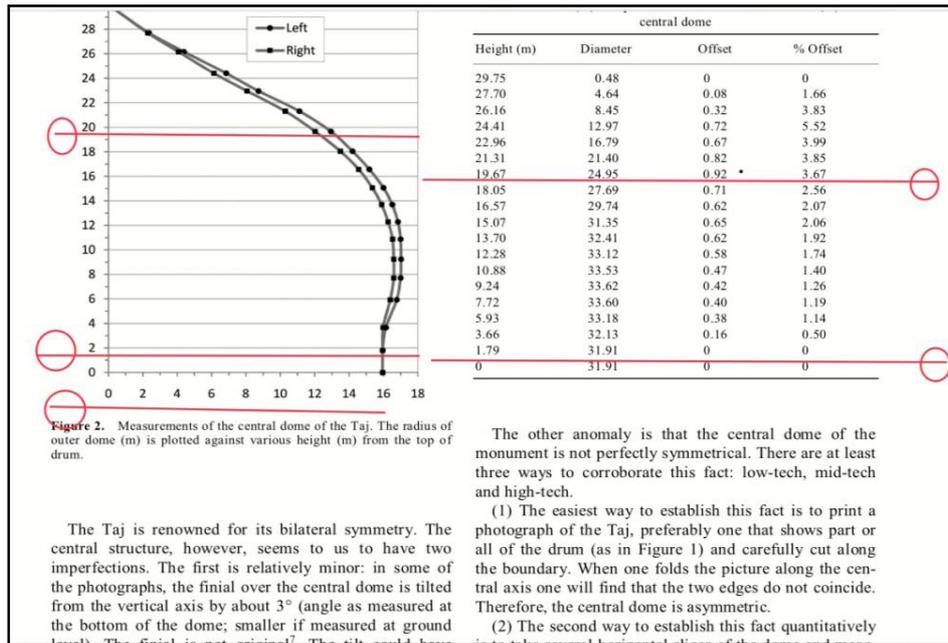
The other anomaly is that the central dome of the monument is not perfectly symmetrical. There are at least three ways to corroborate this fact: low-tech, mid-tech and high-tech.

(1) The easiest way to establish this fact is to print a photograph of the Taj, preferably one that shows part or all of the drum (as in Figure 1) and carefully cut along the boundary. When one folds the picture along the central axis one will find that the two edges do not coincide. Therefore, the central dome is asymmetric.

(2) The second way to establish this fact quantitatively is to take several horizontal slices of the dome and measure the two sides across the central axis. Figure 2 plots the radii of the two sides of the outer dome (shown in

These experts, on advance studies, have tried their level best to prove the slight inter factions in the symmetry of central dome by the physical experiments on a printed photograph of Taj – taken from anywhere and one that shows part or all of the drum (which is not possible to take from any photograph of Taj). Figure shown in their study.

- 1) They have never mentioned the size of the photograph – which is very important in their study because-
- 2) One way to establish this fact quantitatively is to take horizontal lines of the dome and measure the two sides across the “**central axis**”. Figure 2, plots the radius of the two sides of the “**outer drum**” shown in figure-1 which is the photo of Taj Mahal along with smaller dome of the Taj. How the authors have taken the slices of the drums and plotted on which size of graph? (Standard printed call based graph will not be easily available in the market). As the size of graph is very important because there are more errors in a small sized graph.
- 3) The 'so called' measurements taken of slices are on which calibrated scale of measurement? One cannot measure the length of so cut slices by using normal 10<sup>th</sup> class standard of scale.
- 4) However, the so measured slices – on such scale will have a major error in measurement on the scale of drawing of such photographs on paper graphs as they have the size of a general copy used by the students of class 10<sup>th</sup>.
- 5) What was the “**scale of drawing**” with reference to the cutting pieces of slices of the photograph?
- 6) Conversions of “diameter” & “height of dome” data’s on such scale of graph & measurement by the 10<sup>th</sup> class standard of scale – will never be accurate on such plotting against various height of dome, meter and radius of outer dome in question for non-symmetry of the central dome.
- 7) Authors have explained it like a “craft class” of 6<sup>th</sup> standard that is 'carefully cut along the boundary' by a ordinary scissors (कैंची) will not give a desirable result (no-not possible) to prove the non-symmetry or imperfections of central dome of Taj Mahal. Take various sizes of photographs of Taj Mahal by small & big scanners. You will find that there are a lot of differences between small photo's compared to bigger photographs.
- 8) Remember that the imperfection is the magnitude of “0.92 meter (maximum) at 19.67 meter height” which was highly **unacceptable** to any Mughal Emperor.



9) Various magnitude of offset shown in the graph at various heights varies from 0.16 meter to 0.92 meter. These figures are alarming in nature and more alarming for any structural engineer because when this is clubbed with the stability of dome – it has certain different meaning and conclusions, as during earthquake or deadly thunderstorm of having wind velocity more than 134KMPH on 1<sup>st</sup> June 2020 and which had damaged the structure of our Taj Mahal.

10) When one folds the picture along the “central axis” one will find that the two edges do not coincide.

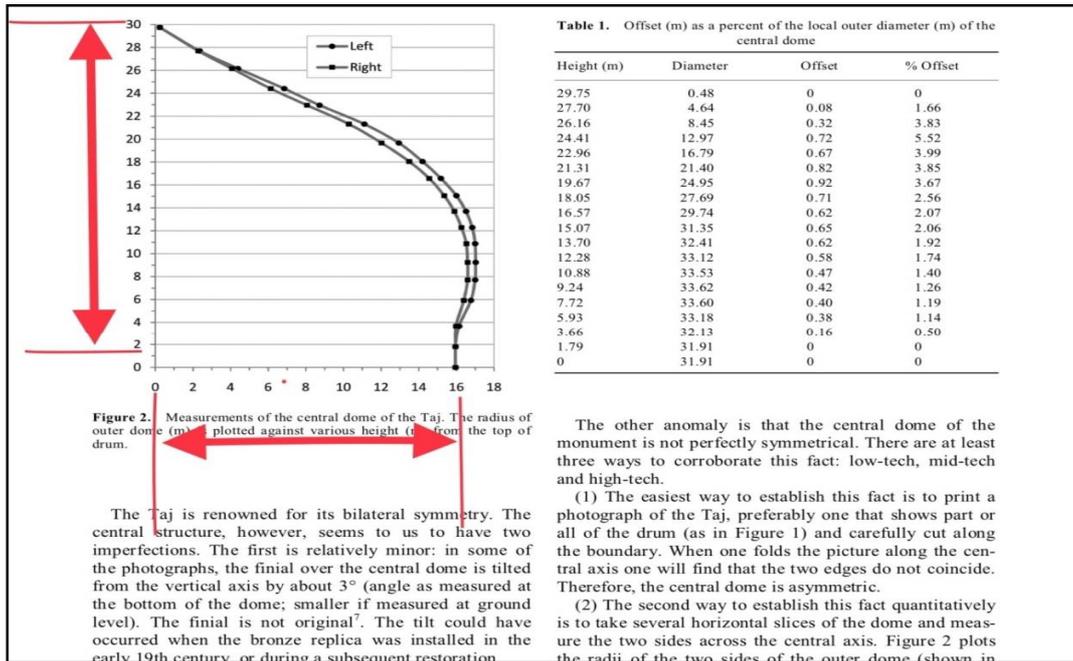
How the authors have come across and found out the central axis of the photographs? The central axis has to be drawn by a thinner carbon pencil of 4H grade with the help of a calibrated protector of engineering standards. The author has not done so.

11) If you take various sizes of scanned pictures of Taj Mahal and find out the central axis as suggested by the authors you will get different result for different sizes of the bigger and smaller photographs of the Taj Mahal. Then one cannot draw such conclusion on the symmetry of Taj Mahal’s central dome, without proper central axis.

### Now we are coming on the most important parts of this concluded asymmetry of the central dome of Taj Mahal

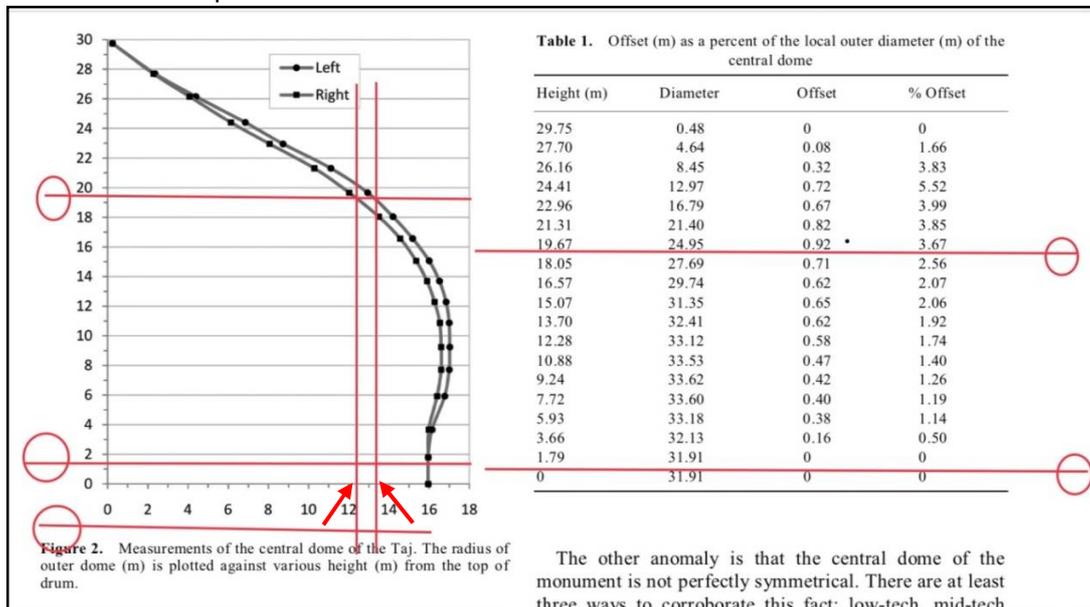
The authors of advanced studies probably must not have the knowledge of the dimensions of the Taj Mahal; otherwise they would have not made such unrealistic mistake, error and manipulation of the data's of the Taj Mahal.

(1) Authors have shown the maximum height of central dome of Taj as 30 meters which it is not?



Reference & Courtesy: [currentscience.ac.in](http://currentscience.ac.in)

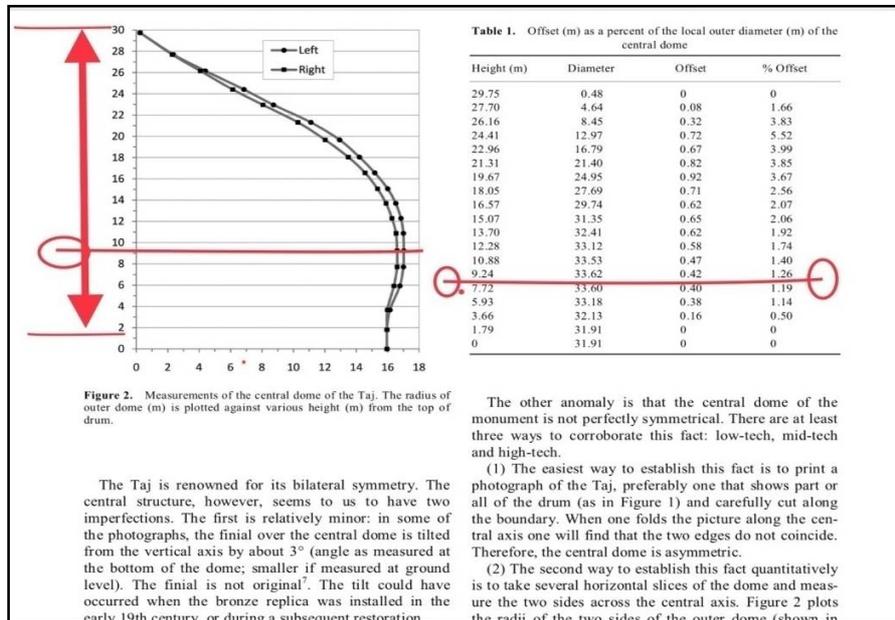
(2) The authors have calculated the measurements of central dome having cylindrical diameter **31.31 meter at zero meter height** as well as at 1.79 meter height (31.31 meter diameter) which is not in actual position.



Reference & Courtesy: [currentscience.ac.in](http://currentscience.ac.in)

At 19.67 meter height the diameter of drum shown by the author is 24.95 meter which does not concede with actual height at site. Also it bisects at the radius 13.4 meter=26.8 meter diameter, whereas on the smaller diameter at 19.67 meter comes out 12.3 meter equal to 24.6 meter, which also does not concede with actual diameter as well as authors calculation.

- (3) The authors have calculated the maximum diameter of dome as 33.62 at 9.24 meter height of dome with having offset 0.42 meter. **Which** is not available in actual dimension.



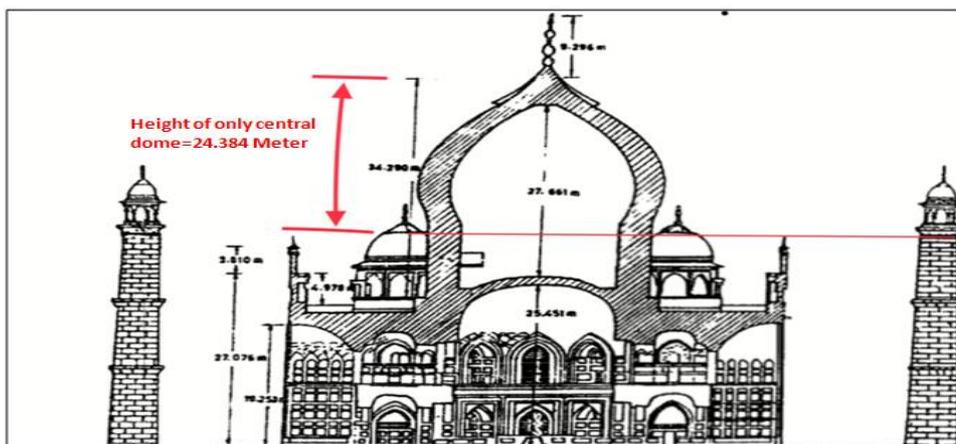
Reference & Courtesy: [currentscience.ac.in](http://currentscience.ac.in)

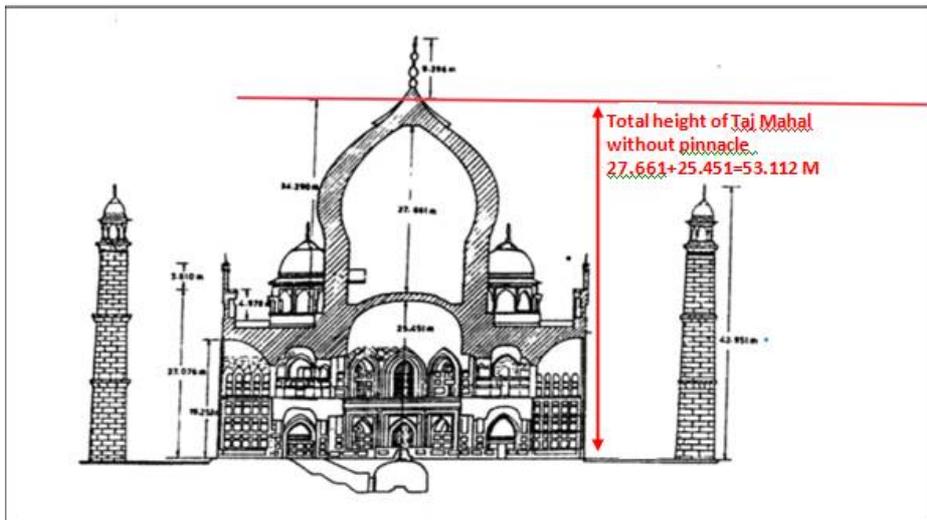
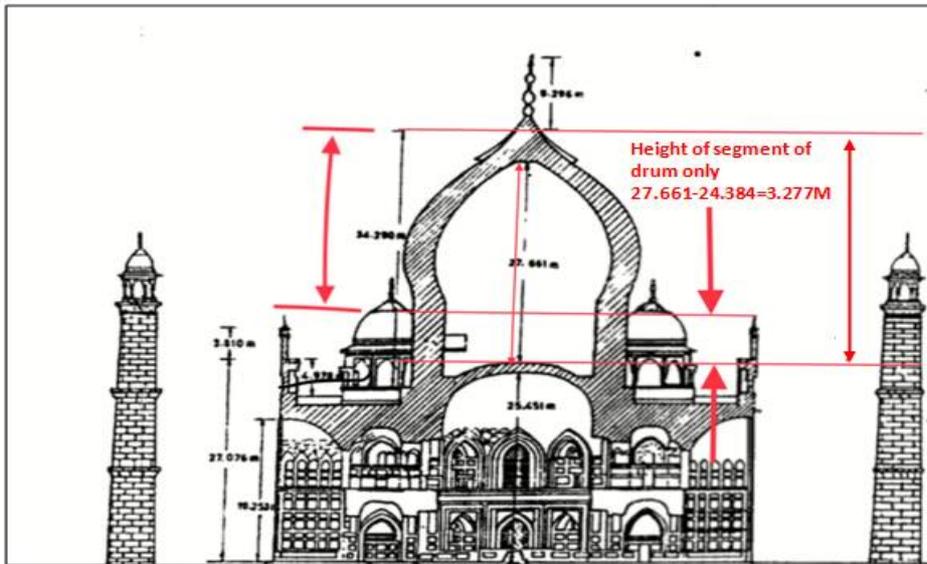
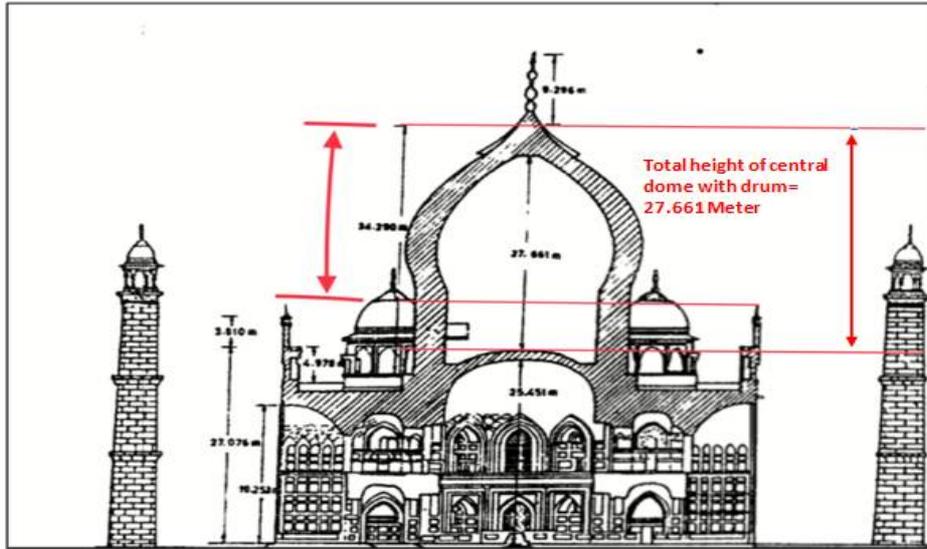
The maximum diameter of dome at 9.24 meter height is 33.62 meter having offset 0.42 meter.

- (4) Diameter of cylindrical portion at zero height is 31.31 meter which is absolutely wrong, as shown by the Author.

From where these dimensions are received and calculated for such a serious finding? Where is everybody's concern for such unremarkable, un-symmetry of central dome of our Taj.

Now please go through the actual dimensions of the Taj – which is shown here with that the maximum height of the central dome is 24.384 Meter (80ft) and cylinder infernal diameter is 58ft without the thickness of wall.





[www.wondersofworld.net](http://www.wondersofworld.net)

**Taj Mahal Wikipedia:** As per Google – picture attached. The outer dome, it rests on a **diameter** of 17 meters and 68 cm and measures 35 meters high. It rests on a drum of 7 meter high (This means the height of simple onion type dome is  $35-7=28$  Meter). A drum is architectural element which is in practice, a very large and very low cylinder arranged vertically and which serves as a support between the building and the drum – a 7 meter high drum is already very big. It is too big the building as a whole would look very long. A drum is look like “neck” of the building. The **interior dome** is 24M and 70 cm tall. Authors are out of range from these dimensions.

1. On a platform 22' high and 313' square. Each tower is 133 feet tall Building is 186 feet high and 70 wide.
2. Corner minarets are 137' tall. Main structure 186' on a side, dome to 187'.
3. The mausoleum is 57 m (190 ft) square in plan.
4. "The central inner dome is 24.5 m (81 ft) high and 17.7 m (58 ft) in diameter, but is surmounted by an outer shell nearly 61 m (200).
5. The Taj stands on a raised, square platform (186 x 186 feet) with its four corners truncated, forming an unequal octagon.

*Reference & Courtesy: aboutcivil.org*

Similar is the case with the diameter of cylindrical drum – which is shown as 16 meter radiuses equal to 32 meter diameter of drum.

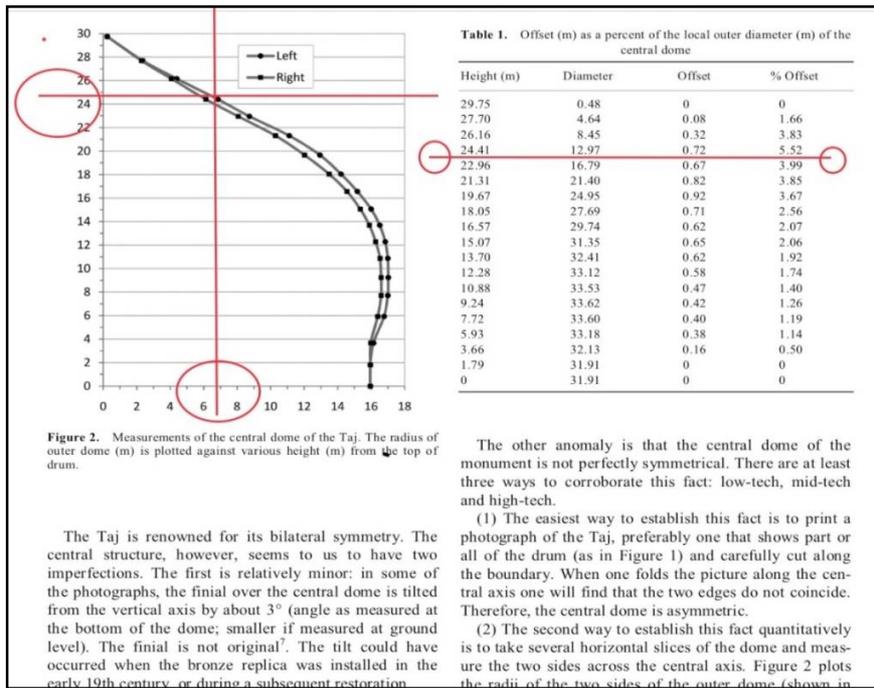
The most spectacular feature is the marble dome that surmounts the tomb. The dome is nearly 35 metres (115 ft) high which is close in measurement to the length of the base, and accentuated by the cylindrical "drum" it sits on, which is approximately 7 metres (23 ft) high. Because of its shape, the dome is often called an **onion dome** or *amrud* (guava dome).<sup>[15]</sup> The top is decorated with a **lotus** design which also serves to accentuate its height. The shape of the dome is emphasised by four smaller domed *chattris* (kiosks) placed at its corners, which replicate the onion shape of the main dome. The dome is slightly asymmetrical.<sup>[16]</sup> Their columned bases open through the roof of the tomb and provide light to the interior. Tall decorative spires (*guldastas*) extend from edges of base walls, and provide visual emphasis to the height of the dome. The **lotus** motif is repeated on both the *chattris* and *guldastas*. The dome and *chattris* are topped by a gilded finial which mixes traditional Persian and Hindustani decorative elements.<sup>[17]</sup>

The main finial was originally made of gold but was replaced by a copy made of gilded **bronze** in the early

## Dimensions about the Taj Mahal

The Taj Mahal is a site much larger than we think, the fault of the mausoleum, so well known that we hide the rest of the site, which is as much worth the look as this marble masterpiece that is the grave itself. The site is 580 x 305m, it is divided into 3 parts, An entry to the South, the **gardens** in the center and the **mausoleum** in the North, as it says in the [description of the Taj Mahal](#).

The white marble mausoleum, the best known of the site's buildings, is an octagon, in fact a square with truncated angles. It measures 58.60m of side for a total height of 73m. It is placed on a base also in marble of 95.16m. Each minaret is 43m high. The **dome**, it is 17.70m in diameter for a height of the arc of 24.4m. It is lined inside by another dome necessarily smaller, which is still 35m high from the ground.



Reference & Courtesy: [currentscience.ac.in](http://currentscience.ac.in)

**Who is Correct? Author or Google**  
 As per author & red line marked

At the height 24.41 meter the diameter of the domes are 12.97 meters. Whereas as per Google photo seen is enclosed here indicates that at the height of 24.4 meter of dome, arch the diameter of dome is 17.70 meter.

So which dimension of the dome is correct, reader should judge the facts. The dimension taken by author is wrong.

- (5) In actual the height of complete dome is 35 meters with having neck of cylinder 7 meters in height.

**So when** the height of dome and diameter of dome are differed with the actual measurement of the **dome of Taj** & the radius of outer dome, the whole findings of the asymmetry of central dome is **determined wrong** and **not acceptable to any structural engineer**.

The plotting of measurements with reference to 30 meter height and 32 meter diameter of cylinder drum is unrealistic and does not match with the measurements data available with the department of ASI & the department of civil engineering, Roorkee, who has furnished some actual different data's of measurements for the working of their different findings at different level.

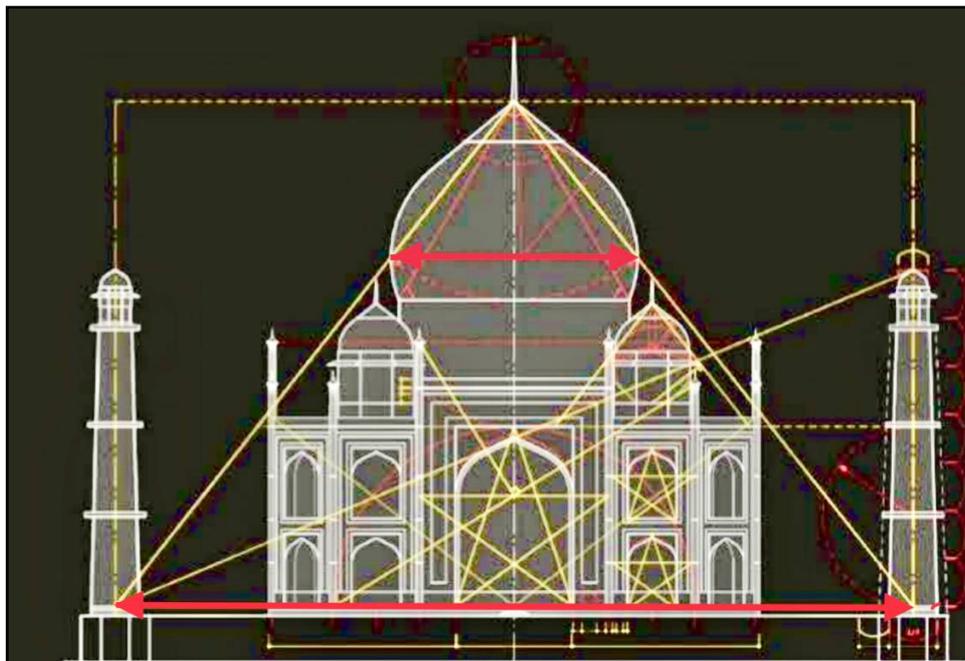
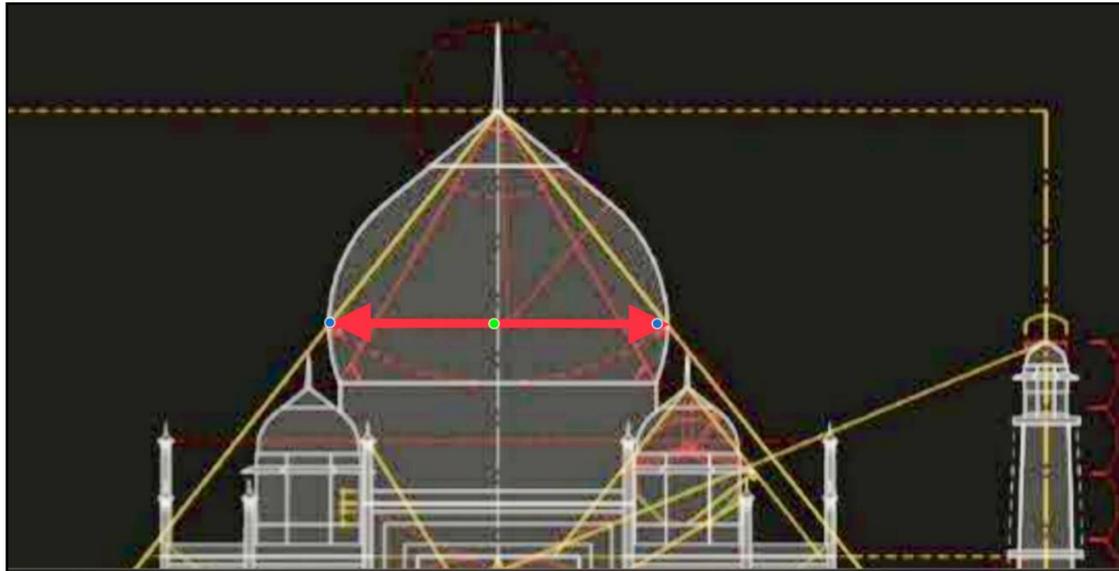
Note: Civil Engineering departments of Roorkee and other institution should conclude the symmetry of the central dome by high resolution-digital **theodolite** which will give the accurate result of symmetry of central dome. We have already verified the symmetry of central dome as

a perfect symmetry for which the following photograph of engineering drawing has the proof of symmetry.

Photograph with Triangle drawings at different points speaks clearly that the central dome in question is mostly perfect and symmetrical with reference to any angle of structural engineering.

**On Two Different equilateral Triangle on Taj - case – 1 for the proof of Symmetry of Taj Dome**

**Who is right? Judge yourself. Taj Mahal central dome is 100% symmetrical.**

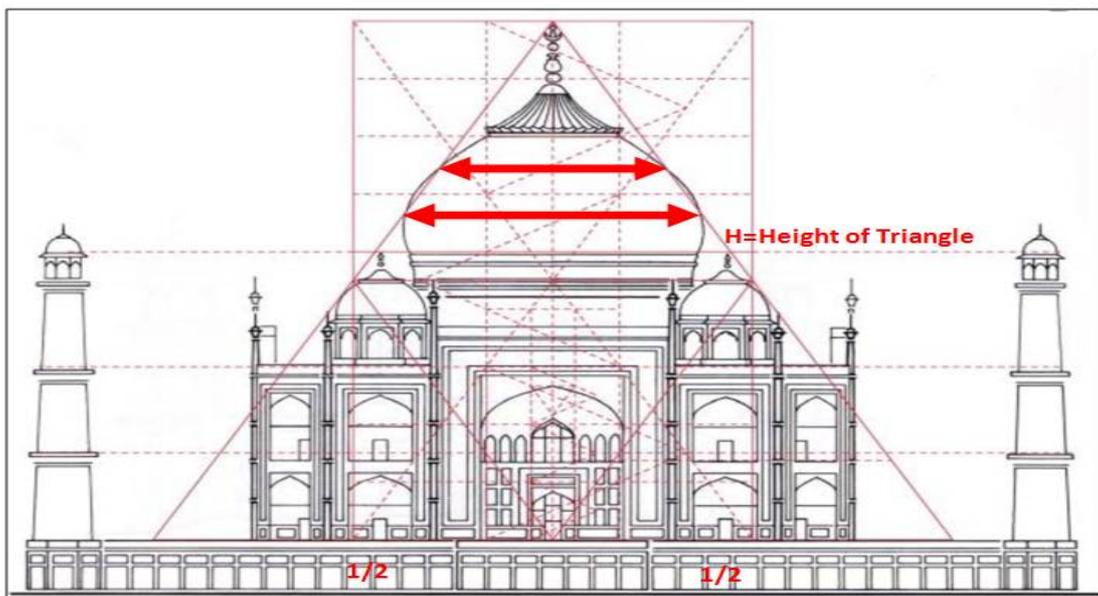


The Taj is in an equilateral triangle in which three sides are equal and three internal angles are also congruent to each other and are each  $60^\circ$ .

Equilateral Triangle proofs that from any point on the central line of Taj – the straight line measured distance – measured (by engineering drawing compass) within onion shaped dome must be equal and is equal at any point, please measure with engineer divider.

Hence, the central dome is most-most symmetrical from any side.

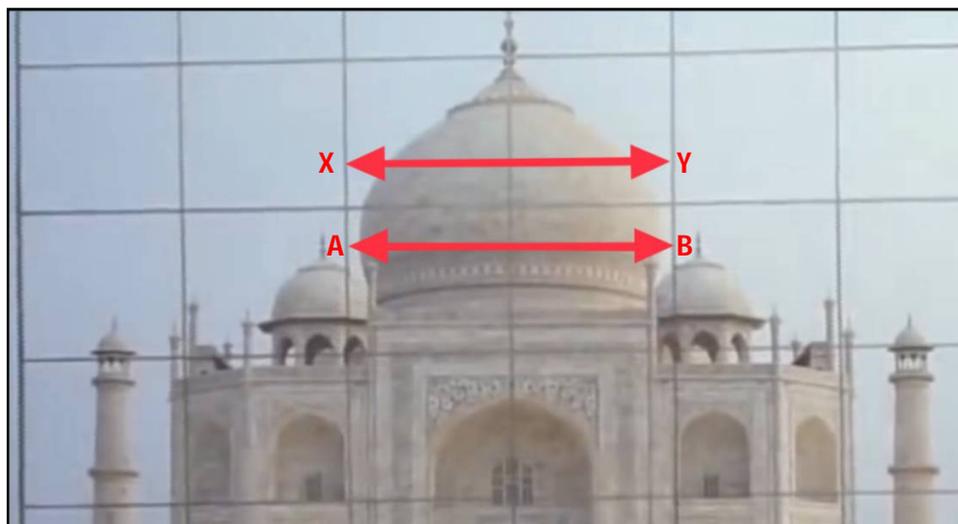
**On different equilateral Triangle as shown in figure-case – 2 for the Symmetry of Dome**  
**Who is right? Judge for yourself. Taj Mahal central dome is 100% symmetrical.**



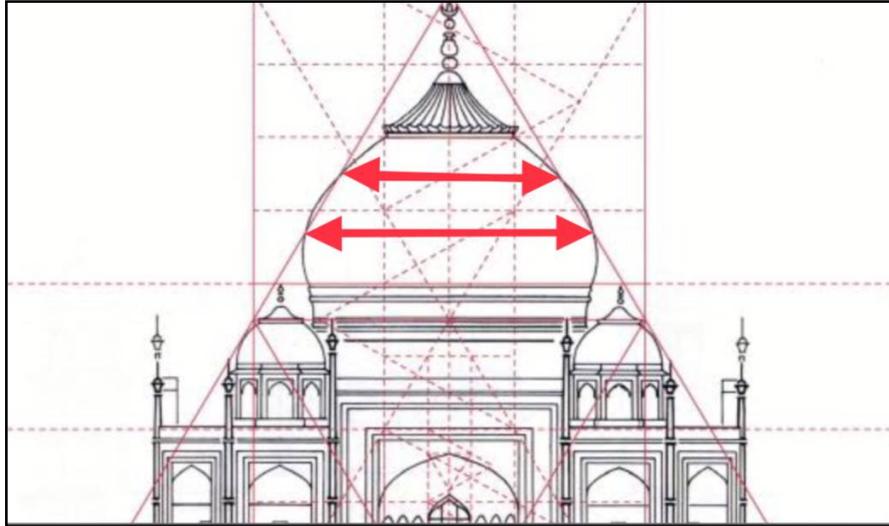
*Reference & Courtesy: BMKTCN-DHXD*

**Case – 3 for the proof of Symmetry of Central Dome of Taj**

**Who is right? Judge for yourself. Taj Mahal central dome is 100% symmetrical. Actual picture of Taj Mahal. Lke authors – Asymmetry on picture.**



Square lines are drawn by the civil engineering drawing-instruments & 4HH pencil on the actual picture of central dome of Taj Mahal. The distance between central line and curved portions of central dome – comes same at any bisects at the dome. Two bisects and the distance of arch between two vertical lines of square are same.



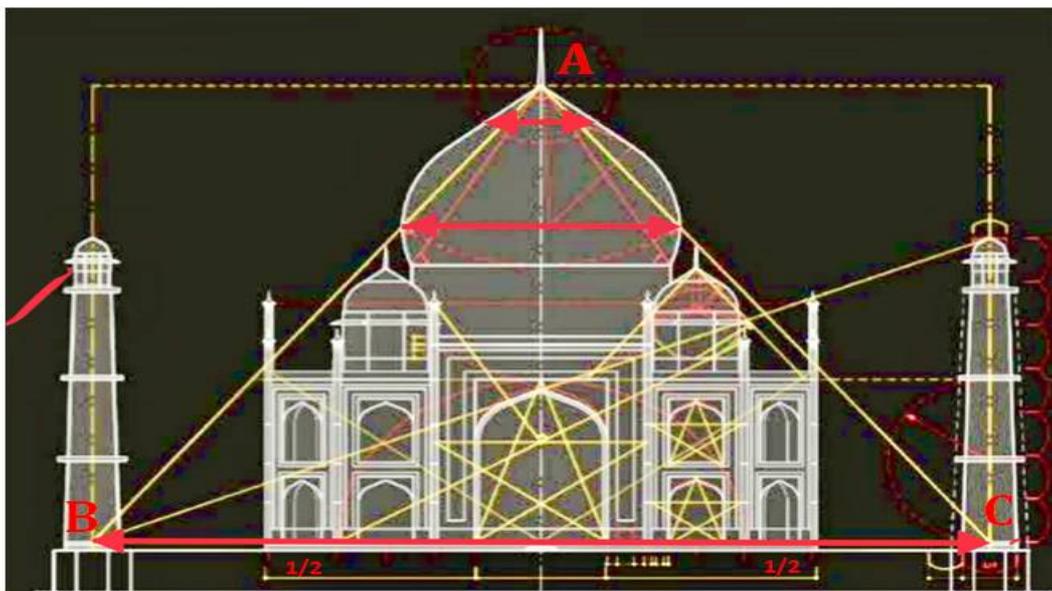
From the central line of central dome – horizontal distance measured from any centre point – dome touches the arch of central dome.

Both side distances are equal as measured by the highly accurate engineering drawing compass and divider. This proves that the Taj Mahal's central dome is symmetrical from any side of dome.

One can plot – these various distances on graphs and complete the dome – you will find that the dome of both sides are equal.

**Equilateral Triangle of Taj of Different Diamention than case 4 – Triangle is bigger & taken from four minar centre.**

**Who is right? Judge for yourself. Taj Mahal central dome is 100% symmetrical.**



In general the height of an equilateral triangle is equal  $\sqrt{3}/2$  time a side of the equilateral AB or BC or AC. All heights come to the same. So the Dome is in Symmetry.

$$h = \sqrt{3}/2 \text{ AB side of Triangle}$$

$$h = \sqrt{3}/2 \text{ BC}$$

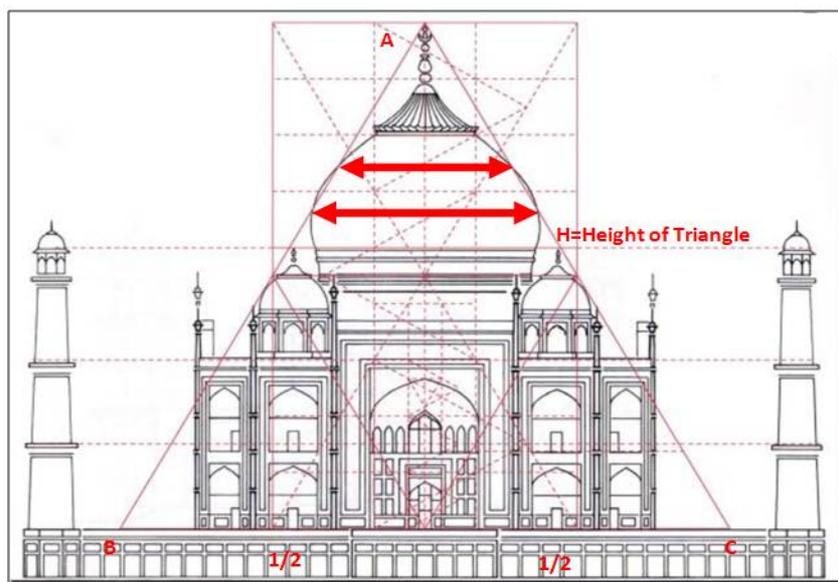
$$h = \sqrt{3}/2 \text{ AC}$$

All must be equal and comes to be equal when measured on any size – print of this Taj – including triangle and the heights comes equal when we calculate, when measured a scan print of this Taj Mahal of various sizes, the height comes to same, in the various prints taken. Do it yourself and get the symmetry of Taj Mahal central onion dome. Measured the length of side AB, BC or AC by civil engineering drawing divider.

$$\text{Area} = \sqrt{3}/4 a^2 \text{ (Equilateral)}$$

$$\text{Height} = \sqrt{3}/4 a$$

**Equilateral Triangle of Different size than–smaller size & smaller base as compared to case-5. Who is right? Judge for yourself. Taj Mahal central dome is 100% symmetrical.**



The area of equilateral triangle is equal to  $1/2$  height x length of any side

$$\text{Area} = \sqrt{3}/4 \times (\text{length of any side of Triangle})^2$$

$$\text{Area} = \sqrt{3}/4 \times (\text{AB})^2$$

or

$$\text{Area} = \sqrt{3}/4 \times (\text{BC})^2$$

$$\text{Area} = \sqrt{3}/4 \times (\text{AC})^2$$

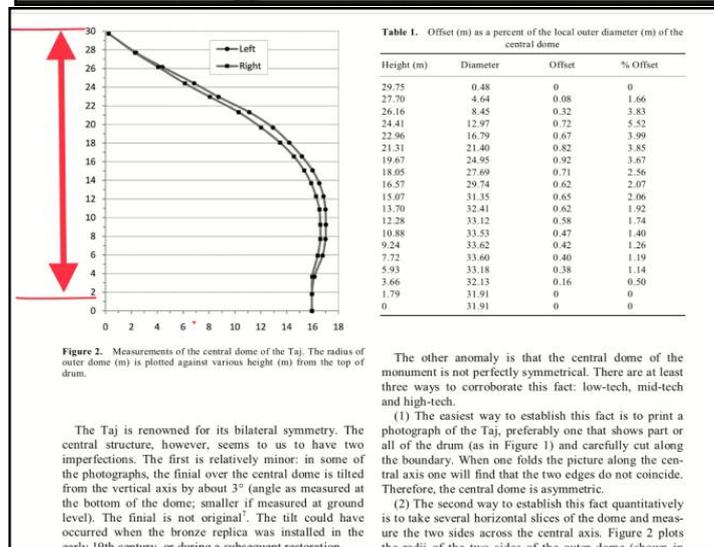
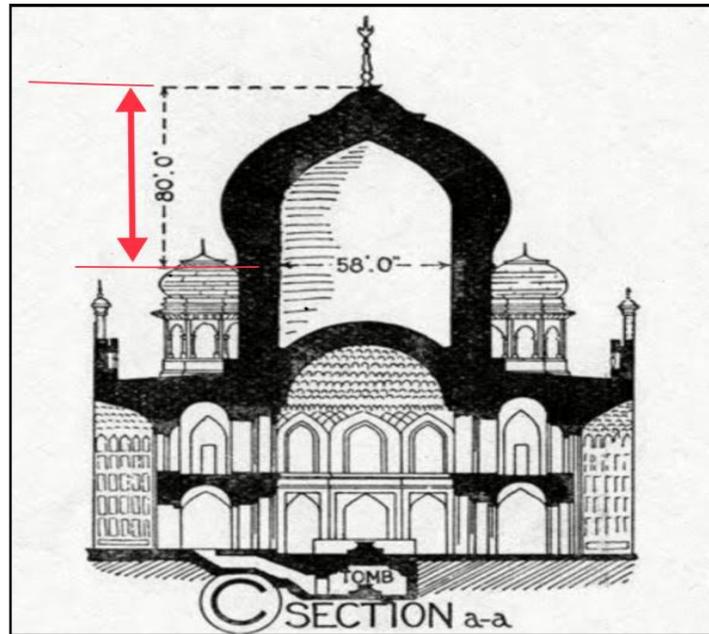
All must be equal and are physically equal, when measured by civil engineering divider. Here we have measured all the sides of Triangle – which are equal to 10.41cms, on the print of this photo. Do it yourself and get the proof of symmetry of Taj Mahal onion dome.

## Important Conclusion on Symmetry of Taj

Note: All the five different cases studied for the symmetry of central dome of Taj Mahal and proofs that the central dome of Taj Mahal is most symmetrical in nature.

### Case 6

Who is right? Judge for yourself. Taj Mahal central dome is 100% symmetrical.



Reference & Courtesy: [currentscience.ac.in](http://currentscience.ac.in)

Actual height of the central dome – includes the portion of cylindrical drum – where the onion type's central dome sits (बैठाना है) 80ft=24.38 meter. Whereas author has shown his height of central dome – 30M-1.79=28.21 meter in his picture.

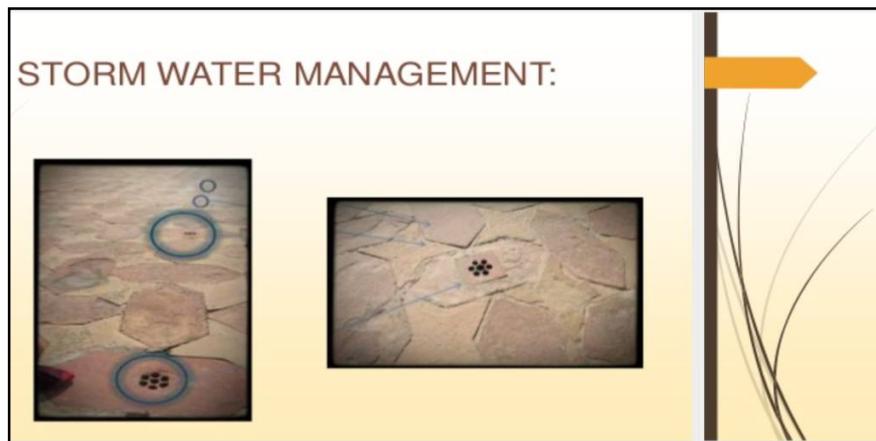
Diameter of central drum is 58ft=17.67 meter + thickness of both walls.

## Other Asymmetry – proved by the author

### Northern Ends of Platform are not differently sinking

- (A) It is also (Not) apparent that the northern and southern ends of platform on which Taj sits are differently sinking over time with northern end towards the river having **sunk 35mm** (In 350 years of existence of Taj) more than the southern end (Two side cannot sink differently).

**Explanation:** These findings of 35mm of civil engineering department of Roorkee in the year 1989-1992 has clearly stated that it has a slope for the purpose of draining the rain water from the platform but not any settlement or sinking, because they have checked this sinking very minutely with reference to the fixed point of Taj. There is no further sinking-as far as their data's is concern.



Slope in the northern side of platform for the purpose of drain the rainwater.

The slight sinking would have not caused the rigid dome to become more asymmetrical over time till this year (August 2020). As symmetry of this is wrong.

### All the four smaller Chhatari are covered by Red stone – so question does not arises for any Asymmetry

- (B) Base of one Chhatari is left (Figure 1) in red sandstone and not covered with marble. An asymmetrical example quoted by author.

Taj shows that the red stone are fixed on all the four minor dome at the plinth



**Explanation:** Not one Chhatari or smaller dome is not left to cover with marble. But in fact all the four chhatari of smaller size has fixed red stone on the plinth of the chhatari. Probably, the authors were not having the bird view of Taj Mahal. The bird view will explain automatically. This asymmetry to the authors. However in engineering subject the plinth is always covered with red stone-which is not having much importance to the visitors.

### Others asymmetry in the structure

**The** authors should know that in the first floor of the main building and gallery, the lime plaster has been on the dome instead of covering by marble slab by the designer of Taj Mahal. Will you count this non-marble fixing in the 1<sup>st</sup> floor & galleries are asymmetrical examples of Mughal Emperor.

- (C) The four minarets of Taj Mahal are out of plumb-are they supposed to be asymmetrical in your nature. They are purposely constructed out of plumb leaning outside from the central platform. Authors will count this fixture for non-symmetry in the structure.

### The Four Minarets of Taj Mahal are out of Plumb & Technically built perfectly stable



Technically when any structure constructed out of plumb, we have to reduce the dead loads of due to the minarets on top, so that it did not tilt big due to high-velocity wind. That is why there is three section or floors in the minarets & the highest length of height is the top portions. Please note.

However, one must also know the facts that these four minarets are built for the purpose of watch & ward of the area, where the watchmen have to stand on the top of the Chhatari of these

minarets and need the balconies placed at three stages of its total height for the stability of minarets.

The designer of such huge most famous structure had purposely made "out of plumb" because in case of any worst happening due to the earthquake or thunderstorm, these minarets did not fall on the Main Taj Mahal. Because of it's "out of plumb" – outward towards the ground.

(D) Nobody knew this, that the south-west minaret is more plumb out than the back-minarets of northern bank. Please go through my book & papers published. **President Donald Trump** was standing near this south-west minaret of the Taj Mahal and was discussing the leaning of minarets with our guide. Why these minarets leans more than other 3 minarets.

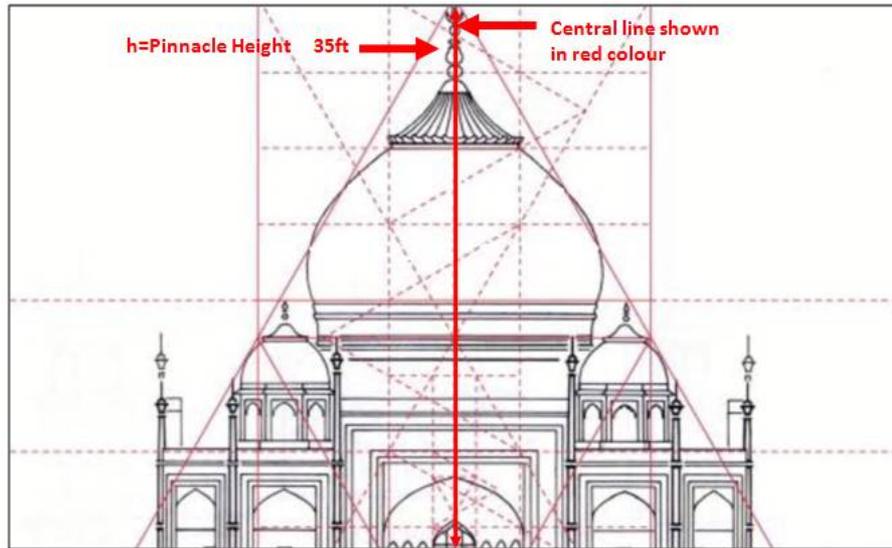
#### President Trump (USA) Visiting Minarets



*Reference & Courtesy: Times Now*



## The finial pinnacle is not tilted from the central axis by 3° angle



The Taj is definitely renowned for its bilateral symmetry. There is “No” imperfection in its symmetry. As per the author, the FINIAL (Pinnacle)  $h=35\text{ft}$  over the central dome is tilted from the **vertical axis** by about  $3^\circ$  (angle as measured at the bottom of dome, smaller if measured at ground level). The tilt could not have occurred – when bronze replica was installed in 19<sup>th</sup> century. But still have the 100% vertical on its axis.

The central line shown in these photographs – coincide with the centre line of the finial (pinnacle-35ft) as well with the central dome.

However, one should understand the technicality of the tilted finial. If by any chance it is tilted by  $3^\circ$  from the central axis, it would have blown out from its bottom by the high speed wind velocity of 150kmh. When there are serious damages on Taj has occurred recently in the year 2018 & June 2020.

Technically the wind forces of 150kmh, will certainly lose its rigidity from the joints. Vibrations force of unbalance finial (tilted by  $3^\circ$ ) and the pressures – created at the different points at finial will create the unbalanced dynamic – displacement of finial and will blow it down to the earth. Please do not try – such type of unsymmetrical in the Main Taj Structure.

### Conclusion

The central dome of Taj Mahal is mostly & perfectly symmetrical with reference to any “angle” of structural engineering concerns. From the above facts & finding which speaks clearly, that the central dome of Taj Mahal in question for asymmetry is not at all asymmetrical.

### निष्कर्ष

मुगल सम्राट बादशाह शाहजहां से इतनी बड़ी गलती हो ही नहीं सकती कि ताजमहल के मुख्य गुमंद की गोलाई की बनावट में बहुत बड़ा अन्तर रह जावे।

-डॉ.राम बजाज (Structural Engineer)

## **0.92 meter maximum difference in two part of central dome is impossible. Before proving none symmetry of central of Taj – one must have the knowledge of “How to construct a spherical dome of Brick Masonry**

In short, for construction of spherical dome, we have to put a fixed centre of dome – permanently without any disturbance to this centre, till the spherical dome or in our case the “onion type bulb” dome of Taj Mahal is fully completed.

Then from this centre of dome, during the construction of brick dome, we have to lay down each and every layer of bricks of spherical dome with respect to this permanent marked centre by the help of string-revolving around this centre. This string or some wooden from of circle is meant for the diameter of the dome at that layer of bricks.

So by doing this revolving the string around centre, the exact diameter of dome is constructed without any “error” in diameter of dome at any place in that layer of bricks.

Each & every layer of bricks laid down for the purpose of construction is thoroughly checked by the experts working on the construction of dome with respect to the radius.

If any layer of radius of bricks laid down is out of plumb from the centre, the next layer of bricks on dome will immediately known to the experts constructing the dome and will immediately rectified any mistake, which is out of circle. Hence there cannot any chance that each & every brick laid on one half part of circle (dome) is smaller and other half part of circle (dome) is bigger like a tune of **0.92 meter** as calculated by the above authors mentioned in this report, the graphs.

For the references various photographs are displayed here to understand by a layman – the actual procedure of construction of spherical dome.

So, inclusion the spherical dome cannot be constructed with having two half of dome having different nature of radius without any knowledge of the experts constructing the central dome of Taj Mahal.

Various photographs showing the various stages of laying the layer of bricks in circle with the help of centre marked and string or having the wooden frame to check the diameter at any place of that layer which is in progress

### **Dome Part – 1**





Dome Part - 2



## On the symmetry of the central dome of the Taj Mahal

Dilip R. Ahuja\* and M. B. Rajani

*The Taj Mahal attracts millions of visitors annually. It is renowned for its perfection, symmetry and attention to detail; its beauty and magnificence appeal to almost all viewers. It does, however, possess some slight imperfections that escape most observers. Revisiting both, the appreciations and criticisms, this study analyses possible flaws in the symmetry of the external central dome and discusses likely reasons for the flaws.*

**Keywords:** Mughal monuments, symmetry in architecture, Taj Mahal.

AMONG the millions who see the Taj Mahal, praise is almost universal. Rabindranath Tagore said that the Taj Mahal rises above the banks of the river like a solitary tear suspended on the cheek of time. Even art historians have been effusive in their praise. Percy Brown<sup>1</sup> described it as 'the "perfect moment" in the evolution of architecture during the Mughal period'. Ebba Koch<sup>2</sup> writes: 'I felt overwhelmed by its perfection, splendour, and sheer size. Eventually I realized that as a scholar I was not alone in my awe of the famous building.' She goes on to analyse the building according to the eight principles of Shahjahani architecture among which she includes geometric planning, symmetry and attention to detail. She claims that 'there is perfect symmetrical planning with emphasis on bilateral symmetry (*qarina*) along a central axis on which are placed the main features'<sup>2</sup>.

In comparison, written criticisms are few. We found only four. In chronological order, the critics are Hermann Keyserling<sup>3</sup>, Aldous Huxley<sup>4</sup>, Sarat Chandra<sup>5</sup> and Wayne Begley<sup>6</sup>. Mostly criticisms are not of the building but they dispute the standard explanation of Shah Jahan's motives for having the monument built.

Count Keyserling, a German philosopher, was unable to fathom the building's meaning. 'As far as the ordinary architectural possibilities go, it lacks all expressive value... The Taj Mahal is not even necessarily a funeral monument: it might just as well, or just as badly, be a pleasure resort... The dead queen is by no means the soul of the Taj Mahal. It has no soul, no meaning which could be deduced from anywhere'<sup>3</sup>. Yet he is clearly in awe: 'A massive marble structure without weight, as if composed of ether; perfectly rational and yet purely decorative; without ascertainable content, and yet full of significance

in the highest degree: the Taj Mahal is not only one of the greatest works of art, it is perhaps the greatest of all pieces of artifice which the creative spirit of man has ever achieved.'<sup>3</sup>

Aldous Huxley was unique in pointing out the building's architectural flaws. 'Architecturally, the worst features of the Taj are its minarets. . . There was no need to make them feebly taper, there was no need to pick out the component blocks of which they are built with edgings of black, and above all there was no need to surround the shaft of the minarets with thick clumsy balconies placed, moreover, at just the wrong intervals of distance from one another and from the ground.' He also criticised the *pietra dura* decorations and the bas reliefs of the flowers which adorn the gateway<sup>4</sup>. Begley<sup>6</sup> dismissed Huxley's views as frivolous.

Sarat Chandra Chattopadhyay's<sup>5</sup> heroine in *Shesh Prashna* expresses doubts about popular explanations of the Taj. 'After pointing out some of the flaws in the myth of Shah Jahan's marital devotion, [she] concludes that the Emperor would probably have built a monument like the Taj even if Mumtaz Mahal had *not* died, that he would have found some other excuse to build it, perhaps "in the name of religion" or perhaps as a "memorial to conquest".'<sup>6</sup>

Wayne Begley provided a novel, and so far the only symbolic interpretation of the Taj – less as a monument to marital love and more as an imagined 'Throne of God'. Both Keyserling and Huxley were unaware of this symbolism. Even Begley admits that 'the Taj possesses the charismatic power to awe almost all its viewers (a few cynics excepted), to instil a sense of greatness, a sense of transcendent majesty'<sup>6</sup>.

We count ourselves among Taj's admirers and neither the reasons for its construction, nor its symbolism concern us. We think it is a building that looks far better during an actual visit than in any depiction. Even repeated visits do not lessen the feeling of gladness that it induces in viewers.

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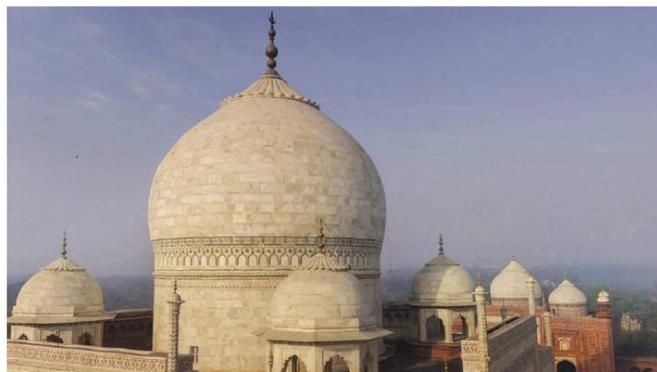


Figure 1. Photograph of the central dome of the Taj Mahal showing the supporting drum.

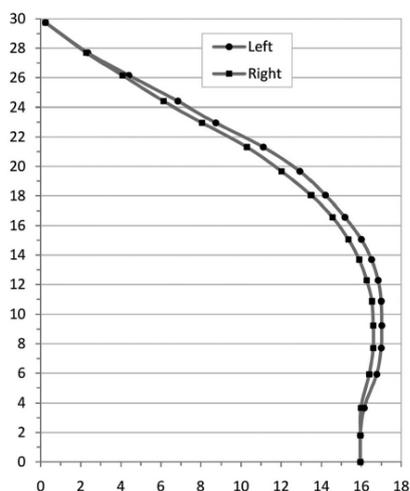


Figure 2. Measurements of the central dome of the Taj. The radius of outer dome (m) is plotted against various height (m) from the top of drum.

The Taj is renowned for its bilateral symmetry. The central structure, however, seems to us to have two imperfections. The first is relatively minor: in some of the photographs, the finial over the central dome is tilted from the vertical axis by about  $3^\circ$  (angle as measured at the bottom of the dome; smaller if measured at ground level). The finial is not original<sup>7</sup>. The tilt could have occurred when the bronze replica was installed in the early 19th century, or during a subsequent restoration.

Table 1. Offset (m) as a percent of the local outer diameter (m) of the central dome

Height (m)	Diameter	Offset	% Offset
29.75	0.48	0	0
27.70	4.64	0.08	1.66
26.16	8.45	0.32	3.83
24.41	12.97	0.72	5.52
22.96	16.79	0.67	3.99
21.31	21.40	0.82	3.85
19.67	24.95	0.92	3.67
18.05	27.69	0.71	2.56
16.57	29.74	0.62	2.07
15.07	31.35	0.65	2.06
13.70	32.41	0.62	1.92
12.28	33.12	0.58	1.74
10.88	33.53	0.47	1.40
9.24	33.62	0.42	1.26
7.72	33.60	0.40	1.19
5.93	33.18	0.38	1.14
3.66	32.13	0.16	0.50
1.79	31.91	0	0
0	31.91	0	0

The other anomaly is that the central dome of the monument is not perfectly symmetrical. There are at least three ways to corroborate this fact: low-tech, mid-tech and high-tech.

(1) The easiest way to establish this fact is to print a photograph of the Taj, preferably one that shows part or all of the drum (as in Figure 1) and carefully cut along the boundary. When one folds the picture along the central axis one will find that the two edges do not coincide. Therefore, the central dome is asymmetric.

(2) The second way to establish this fact quantitatively is to take several horizontal slices of the dome and measure the two sides across the central axis. Figure 2 plots the radii of the two sides of the outer dome (shown in

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Figure 1) for various heights measured from the top of the drum. The non-coincidence of the two edges becomes clearly apparent. Table 1 shows the offset as a function of local diameter of the dome at different heights from the drum. The dome at its widest is 33.62 m, 9.24 m above the top of the drum. The offset here is 0.42 m or 1.26%. The maximum horizontal offset is seen at 24.4 m above the drum, where it is close to 5.5%.

(3) The third and most precise way to establish this fact would be to undertake precise measurements using LiDAR scanning. LiDAR is a technology that measures distance by illuminating the target with a laser and analysing the reflected light. The sensor can be calibrated to a high degree of precision; therefore it would be possible to create an accurate three-dimensional (3D) model of the Taj dome. LiDAR sensors can be mounted on aerial or terrestrial platforms<sup>8</sup> but the size, shape, position and architecture of the Taj dome can pose challenges for measurements. In order to scan the whole dome, sensors will have to image the dome from multiple locations to cover 360°. The position and height of the platform to place the scanner will have to be carefully chosen in order to capture data from multiple locations that then will have to be merged seamlessly.

While we have chosen one particular photograph to illustrate the pronounced asymmetry, this was also discernible to us in photographs taken from many different angles.

Being the first to report an observation comes with the obligation to discuss conjectures. Three possible conjectures present themselves. One, that it was an intentional error. Second, the deformation did not exist at beginning but became accentuated over time, and third, it was a construction error that has existed from the beginning:

(1) Islam holds that only Allah is perfect. We have heard stories that for this reason, Islamic master carpet weavers deliberately introduce a slight error in their carpets that is detectable only by a trained eye. This is unlikely to be the case for the Taj's central dome. There are other small imperfections in the building (not visible from ground level), that seem intentional. For example, Figure 1 shows that the base of the *chattris* is left in red sandstone and not covered with marble.

(2) It is also becoming apparent that the northern and the southern ends of the platform on which the Taj sits are differentially sinking over time, with the northern end towards the river having sunk 35 mm more than the southern end<sup>9</sup>. It seems highly unlikely to us that this slight sinking would have caused the rigid dome to become more asymmetric over time.

(3) The third conjecture, and to us the most plausible one, is that it was imperfect from the beginning. It is an outer dome constructed after the inner dome was finished and therefore perhaps the builders did not have the benefit of a central plumb line. Error could also have crept in as Koch informs us that the Shahjahani linear *gaz* had a

range of 80–82 cm. Field studies conducted with her colleagues have shown that 'it was not an exact unit, but a relative, proportionally used one, the length of which could vary slightly, even within one and the same building complex. For the Taj complex, the average *gaz* is 80.55 cm'<sup>12</sup>.

Would Shah Jahan have been aware of this imperfection? In the absence of direct written evidence, we can only speculate on the basis of counterfactuals. We can find factoids which will support either theory – that he must have known and that he did not know. Let us first consider those facts which might lend support to the did-not-know theory. It is recorded that his eyesight had deteriorated. Muhammad Amin Qazwini, the court historian mentions that Shah Jahan even wore spectacles as constant weeping had deteriorated his eyesight<sup>10</sup>. Given the propensity of Mughal Emperors to order the re-construction of buildings they did not like (cf. the first structure at Sikandra was demolished upon Jahangir's orders), we think his first instinct would have been to have the dome re-built. Numerous references in the Persian histories attest to Shah Jahan's direct involvement in his architectural projects, approving the plans and ordering alterations on the spot<sup>11</sup>. The last argument in favour of the did-not-know theory is that he agreed to be buried in the building, ruining the monument's symmetry.

What factoids support the theory that he might have known? First, there are accounts that after moving his capital to Delhi, he rarely came to visit the Taj. Second, there is the widespread myth that one or a few of the key architects had their hands or fingers chopped. If there is any truth to this myth and punishments were meted out, they were more likely to be for an error than for preventing the construction of a similar monument. However, this is contraindicated by the fact that the same architects helped him build later his capital in Delhi.

It seems incredibly unlikely to us that for someone with his aesthetic sense, he would not have known. More likely, he chose to overlook it. It is quite possible that the artisans may have convinced him that there was no way to guarantee that a second attempt would lead to an improvement given the 'tools' available to them and the complexity of the dome's shape. The Jama Masjid in Delhi, possibly designed by the same architect/s, also has a central bulbous dome (where the widest part of the dome is larger in diameter than the drum it sits on and tapers smoothly into a point thereby creating a more complex curve). Our measurements on the photograph of the Jama Masjid dome reveal similar asymmetry. In the dome of Humayun's tomb, however, the diameter of widest part is same as the drum and thereafter curves inward and tapers to a point. This dome shows more perfect symmetry.

Historians are divided as to whether Shah Jahan wanted to be buried alongside Mumtaz Mahal. His funeral was arranged by his daughter Jahanara. Times had changed.

He had lost control. He was under house arrest for 8 years before his death. Moreover, there was already a precedent for asymmetric placement of a couple's graves in Itmad-ud-daulah's tomb.

Lest we be accused of looking a gift horse in the mouth, is it more beautiful because it has this imperfection? Let us recall what the Count said: 'Let us transpose ever so slightly the proportions, or change its dimensions by an iota, or place the Taj Mahal, as it is, into another region which is subject to different conditions of air, damp and light: it would be the Taj Mahal no longer.'<sup>3</sup> Many other modern buildings appear geometrically perfect but do not have the same effect on the viewer as the Taj. Let us ask the question in another way: Would it have been *less* beautiful had the dome been *more* symmetric? We doubt it. It is imperative to determine whether the asymmetry poses any risk to the structural integrity of the monument.

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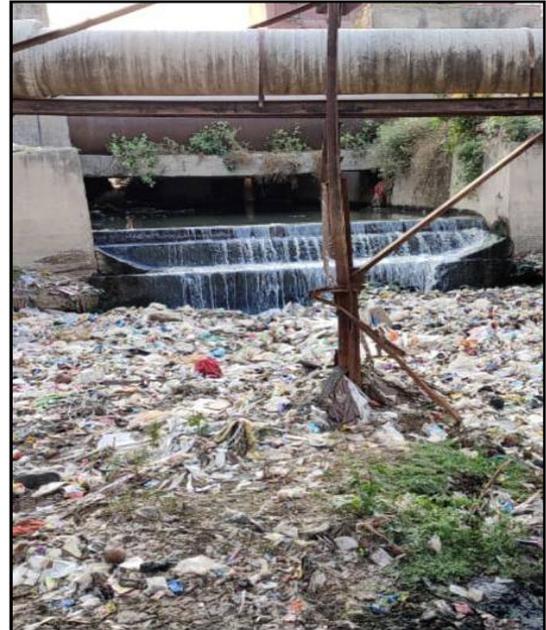
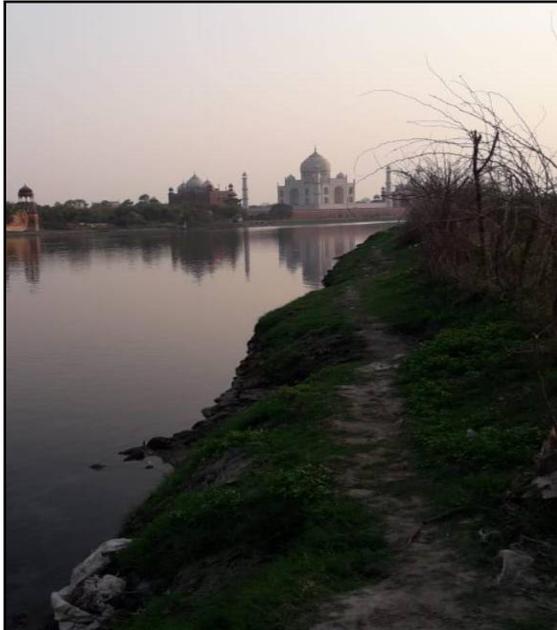
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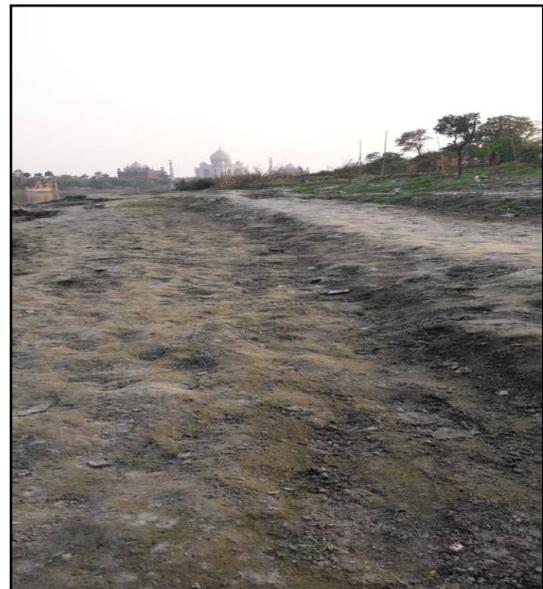
**Dr.Ram Bajaj & his team of experts on spot at Taj Mahal-analysis at various visits.**

**Various Pictures taken by our Experts Team – working of Taj Mahal. These are the pictures during lockdown period.**

Structural Analysis of Taj Mahal at various Technical Angles



Various actual views & pictures of Taj Mahal & River Yamuna-during lockdown period (COVID-19) April 2020 for analysis.



Their pictures were taken from the northern side of Taj Mahal and position of Yamuna River-during lockdown period April 2020 by our team-for analysis.



The contaminated Yamuna River-during lockdown period-for analysis



Road Bridge-where few vehicles are moving on the Yamuna River bridge crossing-Agra during COVID-19 lockdown.



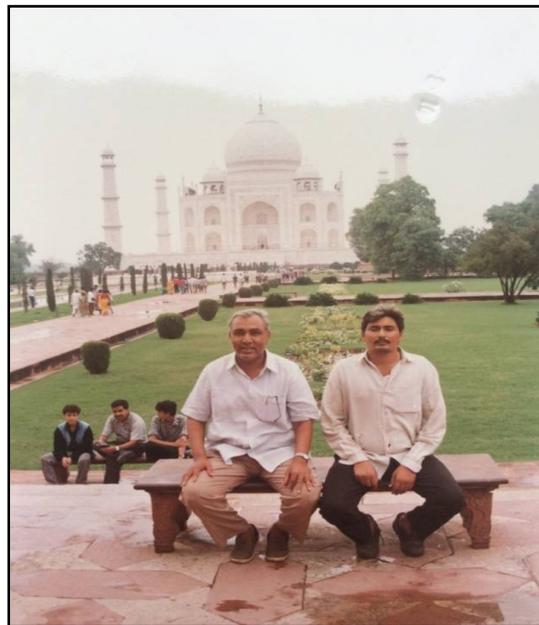
A famous temple of Agra near Taj Mahal is during COVID-19 period April 2020.



Not a single person is seen at Yamuna River of Agra-even Dhobhis who washes the clothes at Yamuna River-are also not seen.



A team member working on the Taj Mahal, standing behind the back portion of Taj Mahal having Yamuna River. (North Side)



Dr.Ram Bajaj – Structural Engineer on spot at Taj Mahal-analysis at various visits.  
Dr.Ram Bajaj & his team of experts on spot at Taj Mahal-analysis at various visits.

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**Note: Your advise will be highly appreciated.**