

The Bartlett School of Architecture
Engineering & Architectural Design MEng: History and Theory Essay, Year 1



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Abstract

The Jantar Mantar in New Delhi is wrapped in mystery, an object to evoke inspiration and imagination and truly an essential and valuable piece of the history of the architecture and astronomy of India. If I were to put it poetically, I like to believe that it's the heart (Misra Yantra looks like an inverted heart), at the heart of the city of hearts, Dilli (local name for Delhi; Dil in Hindi means heart). Yet there is a lot that still remains unknown about this astronomical observatory and in this essay, I intend to explore not just the architectural aspects of its structure but also the disputes through its construction and the reasons for its existence.



Figure 1 : View of the side stairs of the Samrat Yantra



Figure 2 : Personal Sketch of the Rama Yantra

Introduction

The Jantar Mantar is one of the five astronomical observatories made by the Sawai Jai Singh II in North India during the 18th century. The first of these observatories was the one that was made in New Delhi and will be the primary object of my study. The Delhi observatory is located in Connaught Place, (the colonnaded, financial hub of Delhi). It is almost like a fossil, a symbol of the past, in the midst of the hustling-bustling 21st century metropolitan. The compound of the observatory comprises of 13 architectural astronomy instruments (4 distinct instruments) spread across an area with a length of 723 feet. The four unique instruments are Misra Yantra, Jaiprakash Yantra, Samrat Yantra and Ram Yantra. The Misra Yantra can be called the face of the Delhi Jantar Mantar because it is the only structure idiosyncratic to the Delhi Observatory and hence has also made its way to the Delhi Skyline.

Birth of the idea

India and the Indians of the 18th century thrived on their spiritual beliefs, rituals and belief in the existence of a cosmic power. The time and date for any and every auspicious occasion was determined through astrology and by assessing the positions of the stars and the planets in the sky. However, before the construction of the Jantar Mantar, there was a period of disagreement between the Hindu and Muslim astrologers in the court of Muhammad Shah (The Mughal Emperor ruling India). Around the same time, not very far away in the Rajput Kingdom of Amber (in North India), emerged a genius by the name of Maharaja Sawai Jai Singh II. Jai Singh, since a young age expressed keen interest in the fields of Astronomy and Astrology which only intensified as he came into power. Jai Singh always had a relationship of respect with the Mughal rulers who were impressed by his intelligence so when the news of this astronomical dispute reached him, he concluded that the cause of this dispute was largely due to inaccurate astrological tables. He suggested to Muhammad Shah, building an astronomical observatory at Delhi and asked for responsibility of correcting the tables. This led to the birth of the Jantar Mantar.

Motive for its construction

Though it is obvious that the purpose of building the Jantar Mantar was astronomical research however, many historians believe that Jai Singh had more personal reasons for constructing the structures and Muhammad Shah had his own reasons for accepting Jai Singh's proposal. The masses were saturated with superstitious beliefs and were greatly influenced by mythology. In my opinion Jai Singh felt that if they believed he had the power to study the celestial heavenly bodies in the sky, his people would believe he had a divine connection with God, hence strengthening his political hold. Another reason could be that he wanted to be closer to his family ancestry as his family descended from the Sun god. Muhammad Shah also had similar reasons.

Since the Mughal Empire was facing an all-time low, the emperor leaned on astrology and other religious and spiritual ceremonies and so accuracy of planetary positions became a priority. It is interesting to know that by the time Jai Singh was done constructing all five Jantar Mantar's, Muhammad Shah grew extremely jealous of him and the influence he had gained over the people to the point that he banned Jai Singh from his court. In response to this Jai Singh returned his title. And hence the structure that was born from conflict completed full circle and ended with a conflict.

Description of The Compound

Every structure of the Jantar Mantar is planned in accordance with the 'Vastu Shastra'. Vastu Shastra is the traditional Indian system of architecture and is very similar to 'Feng Shui'. According to the rules of the Vastu, a building erected must be situated in such a way that it benefits from both solar and cosmic energies.

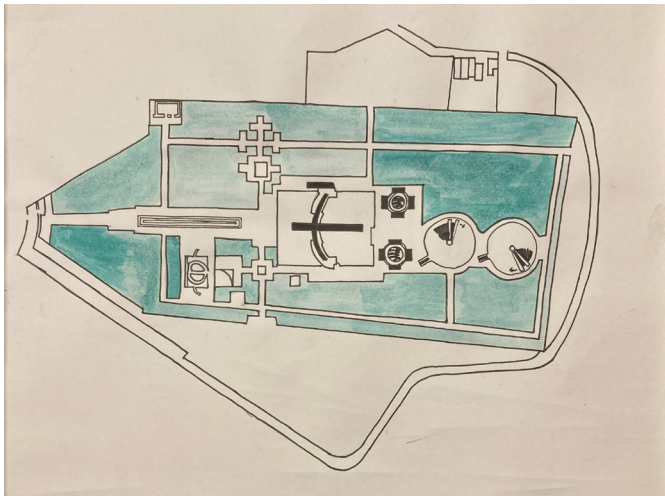


Figure 3 : Personal Sketch of the Floor Plan of Jantar Mantar, New Delhi

Once you enter through the iron gates you enter a compound surrounded by lush greenery and a large number of palm trees (which are not usually found in New Delhi). The first structure to be seen on entering the compound is the massive equinoctial sundial called the Samrat Yantra. As one walks towards it on the right the Misra Yantra can be seen which is the identifier of the Delhi Jantar Mantar. On the other side of the Samrat Yantra are two bowl shaped instruments on either side. These are called the Jai Prakash Yantra. Each of these structures have the bowl shaped yantra surrounded by what appears to be a maze of steps to allow one to access it to take readings. Visually the structure of the Jai Prakash Yantra seems the most complex and is difficult to understand without looking at it from a birds eye view. As one walks on from these the final end of the compound is reached. The last two structures are the identical looking cylindrical structures with their elevation covered with four centre arched windows that were typical of the Rajput Architecture of those days. Its external structure looks somewhat like the colosseum at Rome. However, the inside is circiferenced around a cylindrical pole that connects to the circumference through low lying horizontal strips of red sandstone. All the structures in the complex are made entirely using Red Sandstone and some Makrana Marble.

Architectural Influence

The building style of the Jantar Mantar was extremely different and unique from the works of Hindu and Mughal Architecture. The buildings and structures before the Jantar Mantar were either attempts by the monarchs to assert their power and dominance or grand gestures to their wives or at birth or death. Jantar Mantar was not only an entirely different typology in architecture but it was also perhaps the first structure that was born out of the vain and pride of its creator. I like to think of the Jantar Mantar as the offspring of Jai Singh's intelligence and passion. Not only was the Jantar Mantar symbolically different from the architectural examples that came before it but was also a far cry from quintessential Indian Architecture. Hindu Architecture of India, which was mainly comprised of temples, was characterized by intricate carvings and meticulous detailing both on the external facades and in the interiors and the Mughal Architecture, which was mainly comprised of tombs and forts, were characterized by the massive structures, the use of extravagant materials (like precious stones) and engraved inscriptions. The Jantar Mantar, however, borrowed elements from modern architecture. The various structures in the compounds were simple and not overly ornamental. The surfaces are starkly bare. No part of the Jantar Mantar was designed for aesthetics, the walls and the niches all had a purpose. In my person-

al opinion the only identifier of the structure that lets one know it is an example of Indian architecture is the material used for construction and the subtle use of arches.

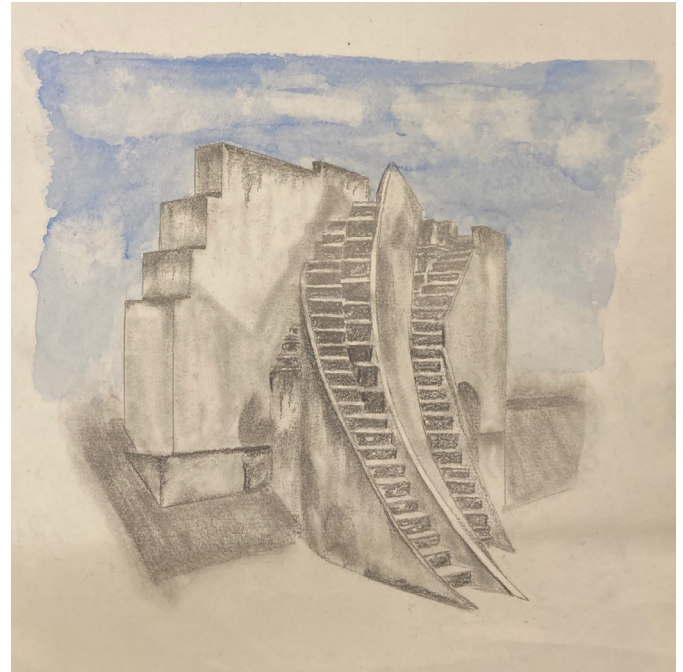


Figure 4 : Personal Sketch of a part of the Samrat Yantra

Materials for Construction

Even though Jantar Mantar had a distinct architectural style, it was mainly built using Red Sandstone and some Makrana Marble. This symbolizes two things. The first is the use of locally available materials. I believe the reason for this is was to lower the cost of construction. The second could be to maintain uniformity in the cityscape. The Red Fort, a magnanimous Fort of Red Sandstone completed in 1648 AD is only 5 km from it and, similarly the Qutub Minar, completed in 1220 AD and 13 km away from it is also made from Red Sandstone and Marble. These are only a few examples to illustrate the attempt to allow Jantar Mantar to blend into the cityscape. Owing to its strength, durability, resistance to abrasion and environmental weathering, acid and alkali resistance and advantage of easy handling and availability has made Indian Sandstone the material.



Figure 5 : (left) Rama Yantra during sunset

Figure 6 : (top) Inside of the Rama Yantra

Exploring Hierarchy

The Jantar Mantar was completely about 300 years ago and so we do not know much about the process of construction. Though it is not certain who worked on the construction of the structures it won't be wrong to assume, taking into consideration the political climate, that it was built by slaves and prisoners of war. This also leads into a much larger discussion of the existence of a cruel caste system in the country at that time which is a separate topic in itself.

Ownership

When talking about a building for the public, I feel it is essential to talk about the aspect of ownership. The ones who made the Jantar Mantar have long passed away so now does it belong to the country, its people, astronomy or historical preservation organisations. If one visits a historical monument in India, the one common feature in all is people's names and declarations of love engraved on almost all surfaces and while its repulsing to see on one hand, on the other hand these engravings add so much more character to the space.



Figure 8 : People's engravings on the wall of Jai Prakash Yantra



Figure 7: Jai Prakash Yantra and Rama Yantra as seen from Samrat Yantra

The government of India has enforced law to protect the sanctity of historic monuments under the Ancient Monuments and Archaeological Sites and Remains Act, 1958, defacing a protected monument is a punishable offence. While laws like this are essential to maintain historic integrity they take away the peoples sense of ownership from the monuments. Eventually all such structures gifted from history are in fact owned by history.

Science and Engineering behind the yantras

Samrat Yantra

The Samrat Yantra standing tall at 22.6 m is the highest structure of the Jantar Mantar at New Delhi. This structure works just as another sundial. In a normal sundial the sun casts a shadow from a vertically mounted triangular plate onto a horizontal surface inscribed with lines indicating the hours of the day. Due to the projection of the sun's apparent circular motion across our sky onto a flat plane, the hour divisions are unequal, being more closely spaced towards the noon hour.



Figure 9 & 10: Views of the Samrat Yantra



When the surface upon which the sun's shadow falls is formed into a circular arc, and aligned perpendicular to the earth's axis of rotation, the passage of the sun overhead casts a shadow which moves across the surface in equal time increments. This type of dial, known as "equinoctial", and is the type of sundial the Samrat Yantra is

Misra Yantra

It is interesting to note that the Misra Yantra was actually constructed after Jai Singh's passing by his son, Madho Singh. The word 'Misra' means mixed and hence this 'mixed instrument' is a combination of five instruments. One is the Samrat Yantra (the quadrants on its east and west side) which is a sundial. The second is the Niyat Chakra Yantra which includes the two semi circles and the central wall and was used to tell the time Greenwich, Zurich, Japan at noon in Delhi. The Karka Rasivalaya Yantra ('Circle of the Sign of Cancer') that was used to tell the sign of the zodiac in the sky, besides marking the summer solstice, is a graduated semi circle on the back of the northern wall of the Misra Yantra. The Dakshinottara Bhatti ('Meridian Wall') Yantra is a graduated semi-circle on the eastern wall of the building and was used to observe the altitude of a heavenly body when it passed the meridian.

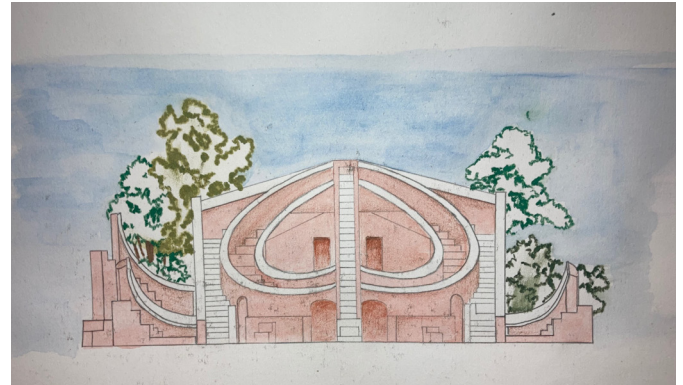


Figure 11 : (left) Close up of Misra Yantra

Figure 12 : (top) Personal Watercolour Painting of Misra Yantra Elevation

Figure 13: (bottom) Detail of arch and stairway below Misra Yantra



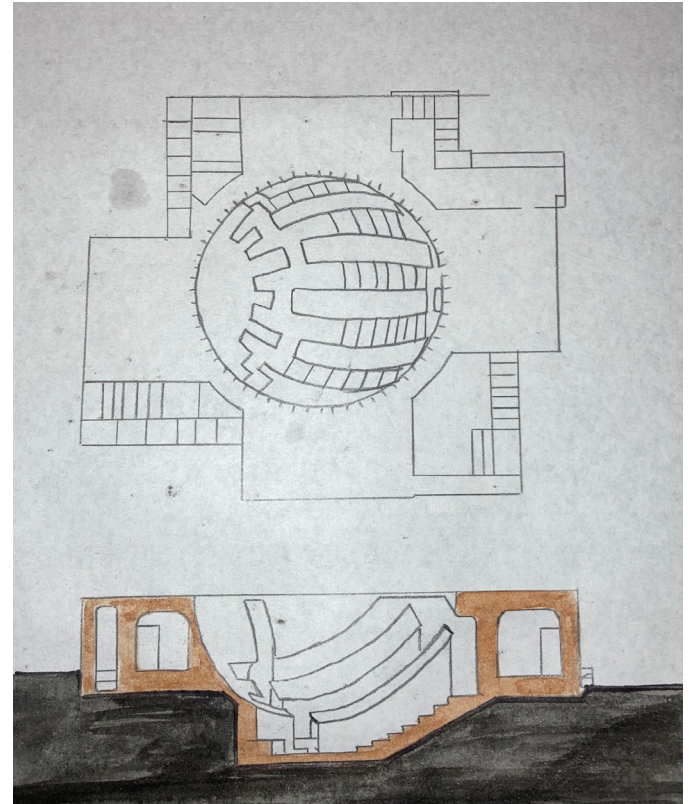
Jai Prakash Yantra

The Jai Prakash is a bowl shaped instrument, built partly above and partly below ground level. The interior surface is divided into segments, and recessed steps between the segments provide access for the observers. A taut crosswire, suspended at the level of the rim, holds a metal plate with circular opening directly over the center of the bowl. This plate serves as a sighting device for night observations, and casts an easily identifiable shadow on the interior surface of the bowl for solar observation.

Figure 14 : Panoramic Image of Jai Prakash Yantar



Figure 15 : Plan and Elevation Section of Jai Prakash Yantra



The surfaces of the Jai Prakash are engraved with markings corresponding to an inverted view of both the azimuth-altitude, or horizon, and equatorial coordinate systems used to describe the position of celestial objects.

Rama Yantra

The Ram Yantra is a cylindrical structure built in pairs like the Jai Prakash. Its primary function is to measure the altitude and azimuth of celestial objects, including the sun. In the Islamic and Hindu schools of astronomy there were no instruments like the Ram Yantra prior to Jai Singh's creations.

Figure 16 a: Personal Model Of Rama Yantra



Figure 16 b: Inside the Rama Yantra

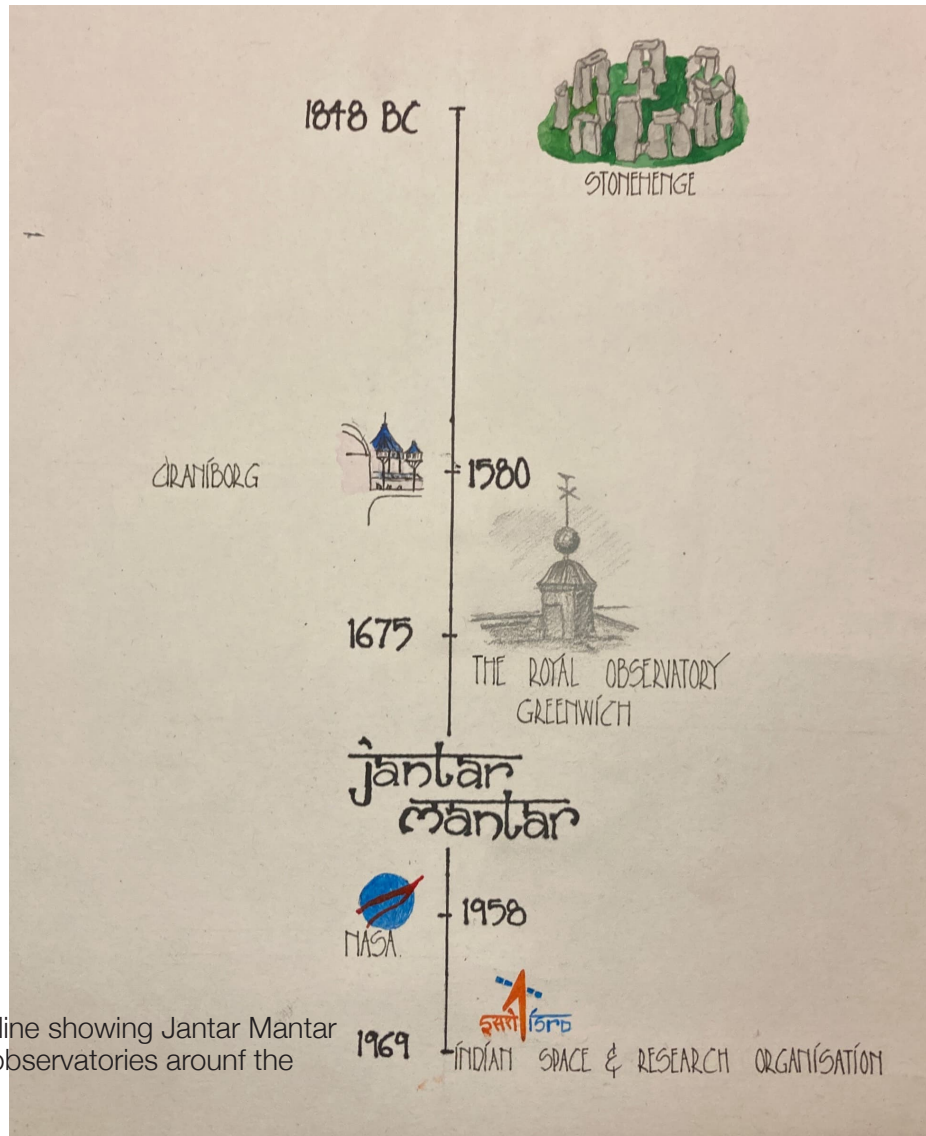


Figure 17 : Timeline showing Jantar Mantar with respect to observatories around the world

The actual use and current purpose

Jai Singh was to use the Jantar Mantar to complete astronomical tables but it is believed that Jai Singh used much smaller instruments to complete the tables as the Jantar Mantar because if its large size was not as accurate as those instruments. Andreas Volwahren's hypothesis suggests that Jai Singh was smart enough to know that instead of building such a grand structure he could have invested the resources in fixing the existing instruments but he decided to do otherwise. It is noteworthy that the observatory was functional for only seven years and thereafter became merely an object of visual admiration. This hypothesis however disregards the Jai Singh's continuous experimentation with the design of his yantra's as well as the observations that were taken from them during the year so of their functionality. When the Jantar Mantar was made three centuries ago it was born purely out of Jai Singh's love for astronomy, science, and progress. Then it was a symbol of hope in a city that was slowly decaying with the empire that ruled it. Through the years, though things have changed, it continues to give the people hope. Every time the country is faced with adversity, people gather at the Jantar Mantar to stand united and fight it. (Jantar Mantar is the designated spot to organise peaceful protests in New Delhi)



Figure 18 : People Protesting outside the Jantar Mantar

Jai Singh's Jantar Mantars

The structures in New Delhi and Jaipur are the most prominent of the five Jantar Mantar's Jai Singh got constructed during his active years. Even though most of the structures in all observatories are somewhat similar, each observatory has its own unique features like the use of Red Sandstone in Delhi as compared to limestone being used in the other cities. Another example of such a distinction is the presence of a 'Chatri' (translates literally to umbrella) at the top of the Samrat Yantra at Jaipur which is a classic element of the Rajput Architecture of Jaipur. The striking feature of the Varanasi observatory is in fact its location on the banks of the Ganges, which makes even this small observatory rather intriguing. The defining feature of the one at Ujjain is definitely its bright white colour unlike the subtle undertones that have been used in all the others. Lastly, not much can be said about the Jantar mantar at Mathura as it was destroyed before 1857.



Figure 19 : Aerial view of Jantar Mantar, Jaipur

Importance of conserving and restoring historical landmarks

Jaipur and Delhi Jantar Mantar's were the only two of the five that are capable to be studied further. Jaipur more than Delhi as the restoration for the Jaipur observatory began in the early 19th century which left important intricacies intact for accurate analysis which the Delhi observatory was unable to provide. The observatories at Varanasi and Ujjain weren't given proper attention and hence are in poor condition and can't be studied as well as the first two. The one at Mathura was destroyed long before any restoration work could be started.

Figure 20 · Personal Acrylic Painting of the



Impact due to development of the city around it

One of the many things New Delhi is most famous for is being the capital with one of the most polluted air in the world. It is inevitable to say that this pollution has a detrimental impact on the city's monuments. This combined with other environmental phenomenon's like acid rain are a few of the reasons that have caused decay of the glorious red of the sandstone used to make the observatory as well as the yellowing of the marble used in some places. The restoration work at the Jantar Mantar is on going but it is safe to say that if one visits the Jantar Mantar, say every two years, they are going to see a different monument everytime when it comes to the colour of the surfaces. This is based on the fact the pictures taken in 2020 were different from the ones found online (around 3-4 years old) which were again different from the ones about 10 years ago.



Figure 21 : Samrat Yantra from afar

The development of the capital has also been detrimental to the observatory. Jantar Mantar being in the centre of Delhi's commercial hub is surrounded by tall buildings on all sides. These include buildings like The Park Hotel and the famous Jeevan Bharti Building to name a few. The observatory lies in the shadow of these high rises which block the sunlight it is supposed to receive hence it is sad to admit that a structure that thrived on the principle of sunlight and shadows, now does not receive adequate sunlight to cast the scientifically planned shadows it was supposed to.

Figure 22 : Overall View of the Complex



Conclusion

The Jantar Mantar of New Delhi though does not perform the functions it was initially made to perform, is an important historical landmark that gives us an insight into the world that existed before us. It is a testament of the past as well as a symbol of Jai Singh's love for astronomy. Though the context of the building has changed through the years from being an aid to science to now being a mere structure for public admiration, it still symbolises the same values of hope, love and unity.

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