# REPORT

# Nehru Planetarium
# Nehru Memorial Museum & Library

Research Project: Jantar Mantar Positional Astronomy
PI – Ms. Megha Rajoria

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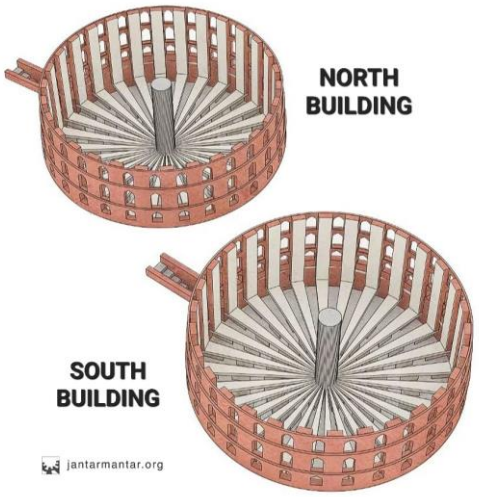
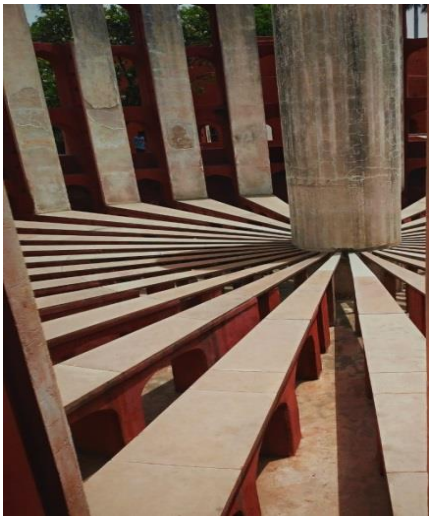
## Yantra under Observation: RAM YANTRA (North-building):

Ram Yantra is a cylindrical structure in two complementary halves that measures the altitude and azimuth of celestial objects. The buildings are constructed along a north-south line. Its inside diameter is 16.65m, and its inner walls have scales ~ 7.51m high, same as the height of the central pillar having diameter 80.6cm. The slab floor is divided into 30 radial sectors raised 1.07m above the ground. The sectors and spaces measure 6° each.

To enhance our comprehension of the instrument's functionality, we four of us conducted a study to measure the local coordinates of Sun (altitude and azimuth) inside the north building of the Ram Yantra on 15th and 21st June, 2023. The data collection process comprised several iterations to ensure accuracy and consistency. So, following is the analysis of data collected.



*Ram Yantra - North Buliding*

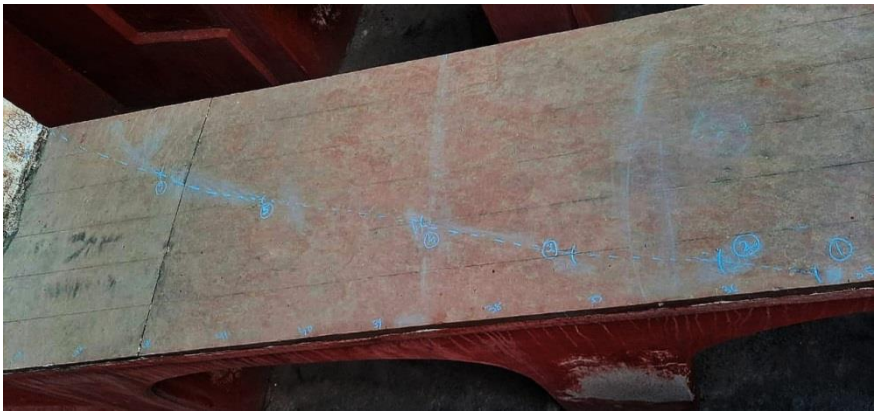
## Observation:

The upper surface of the radial sectors is engraved into concentric arcs one degree apart representing the readings of zenith distance. And, side of the sectors indicates the altitude which has been divided into 10 divisions each. So, it has a least count of 0.1° or 6 arc minutes. But, these divisions are not properly marked in some places, so introducing a little error in measurements. The Gnomon at the center has circular horizontal scale for reading of angle of azimuth.

### Data collected on 15th June, 2023 -

| Clock Time IST (H:M:S) | Zenith Distance, z (°) | Observed Altitude, α (°) | Actual Altitude, α(°) | %age error | Observed Azimuth, γ (°) | Actual Azimuth, γ (°) | %age error |
|---|---|---|---|---|---|---|---|
| 14:57:08 | 35.2 | 54.8 | 54.803 | 0.005 | 270.2 | 270.395 | 0.072 |
| 15:00:41 | 35.9 | 54.1 | 54.025 | 0.13 | 270.5 | 270.81 | 0.1 |
| 15:05:06 | 37.1 | 52.9 | 53.057 | 0.2 | 271.0 | 271.32 | 0.12 |
| 15:13:15 | 38.7 | 51.3 | 51.27 | 0.05 | 272.0 | 272.22 | 0.08 |
| 15:22:47 | 40.8 | 49.2 | 49.18 | 0.04 | 273.0 | 273.24 | 0.08 |
| 15:30:54 | 42.5 | 47.5 | 47.409 | 0.19 | 274.0 | 274.09 | 0.03 |
| 15:42:20 | 45.5 | 44.5 | 44.91 | 0.9 | 275.0 | 275.25 | 0.09 |

*Here, in the above table Observed data is the data collected from Ram Yantra while Actual data is the Computer-generated data taken from Stellarium software.*



*Altitude and Azimuth variation of the Sun on the horizontal slab, on 15th June, 2023*

## Data collected on 21st June, 2023 (Summer Solstice Day) –

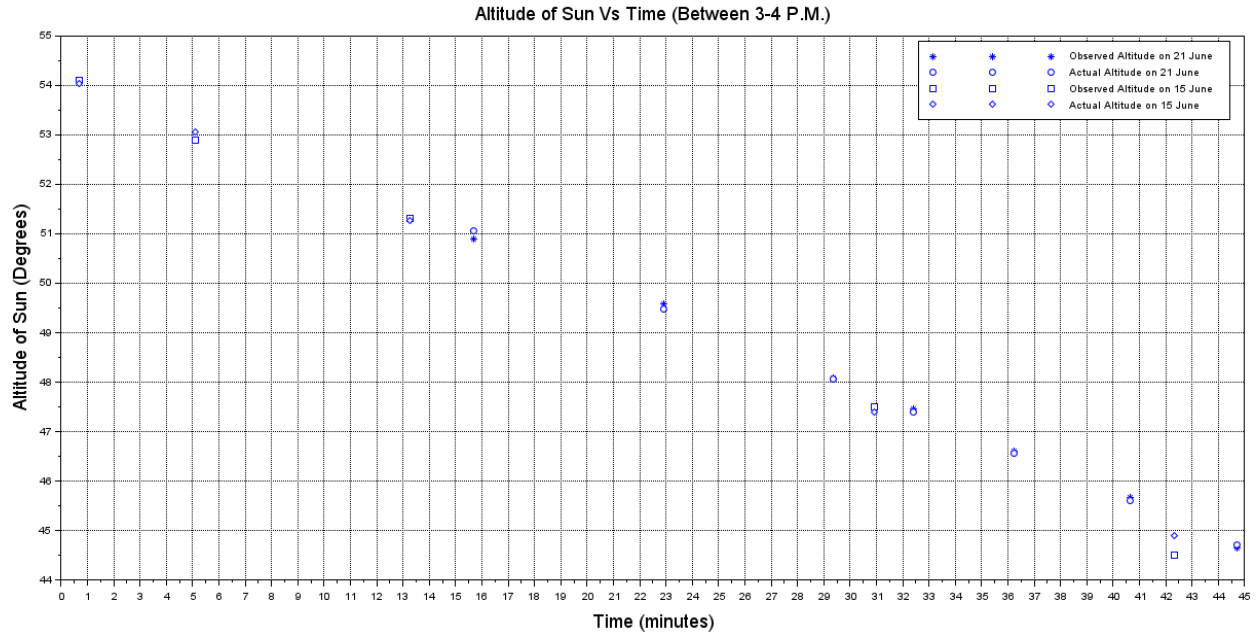
| Clock Time IST (H:M:S) | Zenith Distance, z (°) | Observed Altitude, α (°) | Actual Altitude, α(°) | %age error | Observed Azimuth, γ (°) | Actual Azimuth, γ (°) | %age error |
|---|---|---|---|---|---|---|---|
| 15:15:42 | 39.114 | 50.886 | 51.062 | 0.3 | 272.3 | 272.55 | 0.09 |
| 15:22:55 | 40.41 | 49.59 | 49.48 | 0.2 | 273.2 | 273.32 | 0.04 |
| 15:29:22 | 41.92 | 48.08 | 48.07 | 0.02 | 273.75 | 273.99 | 0.08 |
| 15:32:25 | 42.53 | 47.47 | 47.405 | 0.13 | 274.3 | 274.302 | 0.0007 |
| 15:36:13 | 43.39 | 46.61 | 46.57 | 0.08 | 274.6 | 274.69 | 0.03 |
| 15:40:38 | 44.33 | 45.67 | 45.61 | 0.1 | 275.0 | 275.13 | 0.04 |
| 15:44:43 | 45.34 | 44.66 | 44.72 | 0.13 | 275.5 | 275.54 | 0.01 |

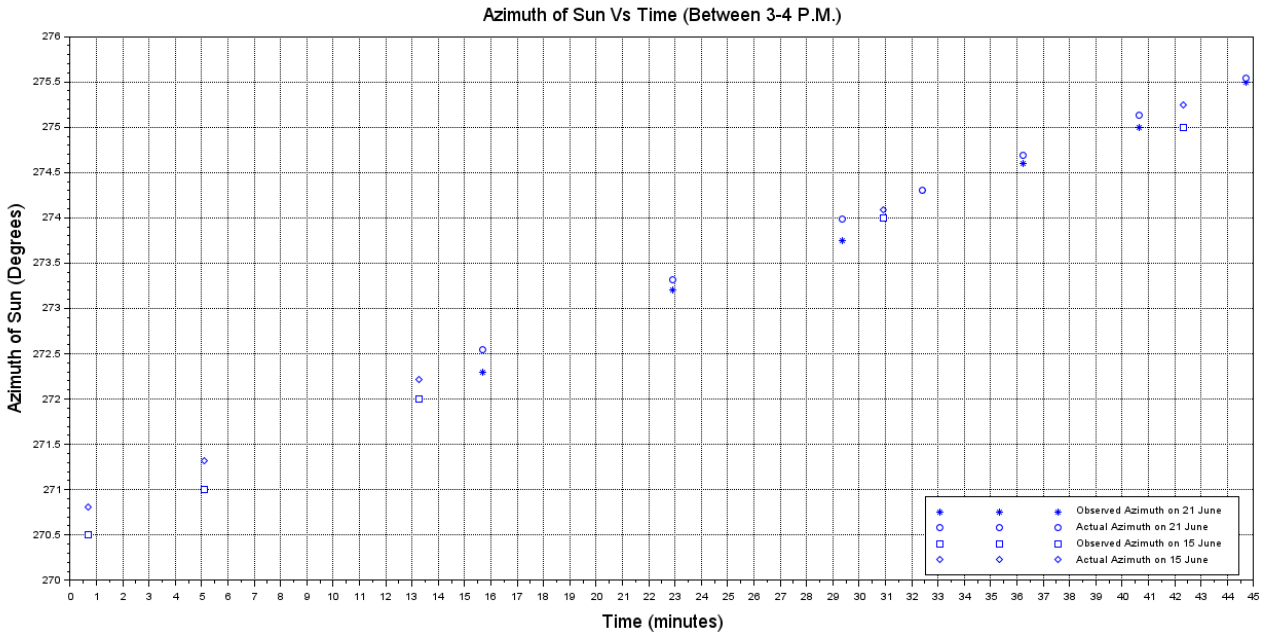
*Here, in the above table Observed data is the data collected from Ram Yantra while Actual data is the Computer-generated data taken from Stellarium software.*

*Altitude and Azimuth variation of the Sun on the horizontal slab, on 21st June 2023*

## Plots:

Below are the plots comparing the observed data (altitude and azimuth) with computer-generated data by Stellarium software, from the instrument Ram Yantra - North building.




## Conclusion:

The measurement of the Sun's coordinates within the North building of Ram Yantra has provided the valuable insights into the instrument's capabilities. The study demonstrated the importance of data up to a better accuracy.

## Acknowledgement:

We would like to express our gratitude to the P.I. of this project Miss Megha Rajoria for her assistance throughout the research and also grateful to Nehru Planetarium and Archaeological Survey of India for their support.

## References:

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