



Collaborative for Air Pollution and Health Effects Research -India

Monitoring of Air quality inside AIIMS, New Delhi hospital campus A status report

Contributors

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Contents

1. Background-	3
2. Objective	3
3. Method-.....	4
3.1 Calibration of AirVeda sensor	6
4. Results (Baseline assessment)	7
4.1 OUTDOOR LOCATIONS	7
4.1.1 Major pollutants	7
4.1.2 Diurnal variation of pollutants	9
4.1.3 Air Quality Index (AQI)	11
4.2 INDOOR LOCATIONS.....	12
4.2.1 Major pollutants.....	12
4.2.2 Diurnal variation of pollutants	15
4.2.3 Air Quality Index (AQI)	18
5. Conclusion	19
6. End assessment-.....	19
ANNEXURE.....	20

1. Background

Air pollution is responsible for many health problems in urban areas. The air pollution status in Delhi has undergone many changes in terms of the levels of pollutants and the control measures taken to reduce them; All Indian Institute of Medical Sciences (AIIMS) is situated at the heart of National Capital Territory (NCT), and keeping in mind about the Particulate Matter (PM) values in this region; it is necessary to get the detailed PM_{2.5} values and diurnal pattern of PM₁₀ and PM_{2.5} in different microenvironments of AIIMS. This initiative is with reference to the meeting with the collaborative for Air pollution and Health effects research under (CAPHER-India) on 31.01.2023 [Ref no- F.No.40-30/2022-Estt-I (DO)]. (See Annexure) It has been decided that activity of monitoring of Air Quality in AIIMS hospital campus will be done. This is a collaborative work between IITD-AIIMS under CAPHER-India.

2. Objective

The objective of this initiative is to measure the Ambient Air Quality (AQI) using low-cost sensors in the different microenvironment of AIIMS campus; small set of measurements in this study provides an evidence-based insight into the status of air pollution at AIIMS.

3.Method

In this initiative, we used the low-cost indoor and outdoor units from an Indian based startup *AirVeda*. We had planned to deploy the indoor/Outdoor units at nine different locations (4 Indoor and 5 Outdoor) inside AIIMS campus.

Location (Outdoor Units)	Start day	End date	Status
Gate No.2 Director's office	22 nd Feb 2023	5 th Mar 2023	Completed
New RAK OPD	22 nd Feb 2023	5 th Mar 2023	Completed
Exit of Gate No. 1	3 rd Mar 2023	16 th Mar 2023	Completed
Emergency Medicine 1 (EM1)*	-	-	
Gate no. 3 road junction*	-	-	
Location (Indoor Units)			
Foyer area	19 th April 2023	3 rd May 2023	Completed
B.B Dikshit Library	21 st April 2023	3 rd May 2023	Completed
Medicine Ward	4 th May 2023	16 th May 2023	Completed
Old OT Block	4 th May 2023	16 th May 2023	Completed

* Installation of sensors were not possible

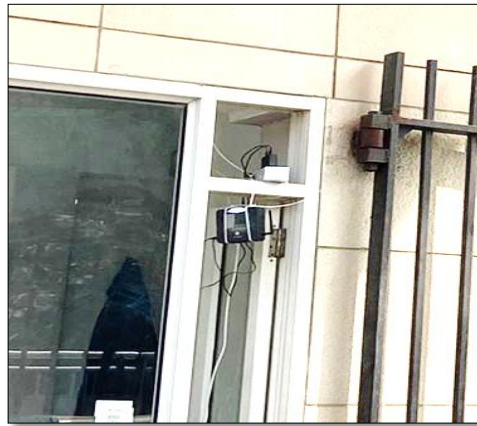
- First, we collocated all the indoor and outdoor units for a week and checked the performance of all the units.
- The Outdoor Unit was deployed at three different locations : at Gate number 2 and new Rajkumari Amrita Kaur OPD from 22nd February to 5th March 2023 and at Exit of Gate No.1 from 3rd March to 16th March 2023. (Figure 1) At the end measurements (PM2.5, PM10) was compared with the nearest regular monitoring instrument by CPCB/DPCC.
- We also chose four indoor locations for PM2.5 and PM10 measurements. The indoor units at Foyer area were installed from 19th April to 3rd May,2023; B.B. Dikshit library from 21st Aril to 3rd May,2023 .The remaining indoor units at Medicine ward and Old OT Block were installed from 4th May 2023 till 16th May 2023 before removing them (Figure 2).



OUTDOOR UNIT AT GATE NO.2



OUTDOOR UNIT AT EXIT GATE NO.1



OUTDOOR UNIT AT NEW RAK OPD

Figure 1: Outdoor units installed at Gate no. 2, Exit Gate no.1 and New RAK OPD



INDOOR UNIT AT FOYER AREA



INDOOR UNIT AT B.B. DIKSHIT LIBRARY



INDOOR UNIT AT OLD OT BLOCK



INDOOR UNIT AT MEDICINE WARD

Figure 2: Indoor units installed at Foyer area, B.B.Dikshit Library, Old OT block and Medicine ward

3.1 Calibration of AirVeda sensors-

These low cost sensors are provided by IITD ,Centre for Atmospheric Sciences led by Dr. Sagnik Dey. The sensors were calibrated with the real-time monitoring device (BAM) at the Centre for Atmospheric Sciences, Block-6 rooftop, IITD. All of them are well-calibrated and show an accuracy of 90-95% with the real-time monitoring device. After collecting the data from one site immediately, all these low-cost monitoring sensors are again put together for 48 hours on a collocation test bed at IITD for checking the accuracy. Further calibration analysis is performed and then they are deployed to a new location.

4. Results (Baseline assessment) –

4.1. OUTDOOR LOCATIONS

4.1.1 Major pollutants :

- PM2.5 - The highest concentration of PM2.5 at Gate no.2, new RAK OPD and Exit Gate no 1 were 260 $\mu\text{g}/\text{m}^3$, 313 $\mu\text{g}/\text{m}^3$ and 239.5 $\mu\text{g}/\text{m}^3$ respectively.(Refer Fig 3,5 & 7)
- PM10 : The highest concentration of PM10 at Gate no.2, new RAK OPD and Exit Gate no 1 were 410 $\mu\text{g}/\text{m}^3$, 466.5 $\mu\text{g}/\text{m}^3$ and 394.5 $\mu\text{g}/\text{m}^3$ respectively. (Refer Fig 3,5 & 7)
- CO2: The highest concentration of CO2 at Gate no.2, new RAK OPD and Exit Gate no 1 were 1004.5ppm , 1046ppm and 1301ppm respectively. (Refer Fig 4,6 & 8)
- TVOC: The highest concentration of TVOC at Gate no.2, new RAK OPD and Exit Gate no 1 were 5403ppb , 3165 ppb and 2418 ppb respectively. (Refer Fig 4,6 & 8)

For major pollutants, it can be seen that amongst all the outdoor locations, the PM2.5 and PM10 peak concentrations can be found at new RAK OPD whereas for CO2 and VOC the same is true for Exit Gate no.1 and Gate no.2.

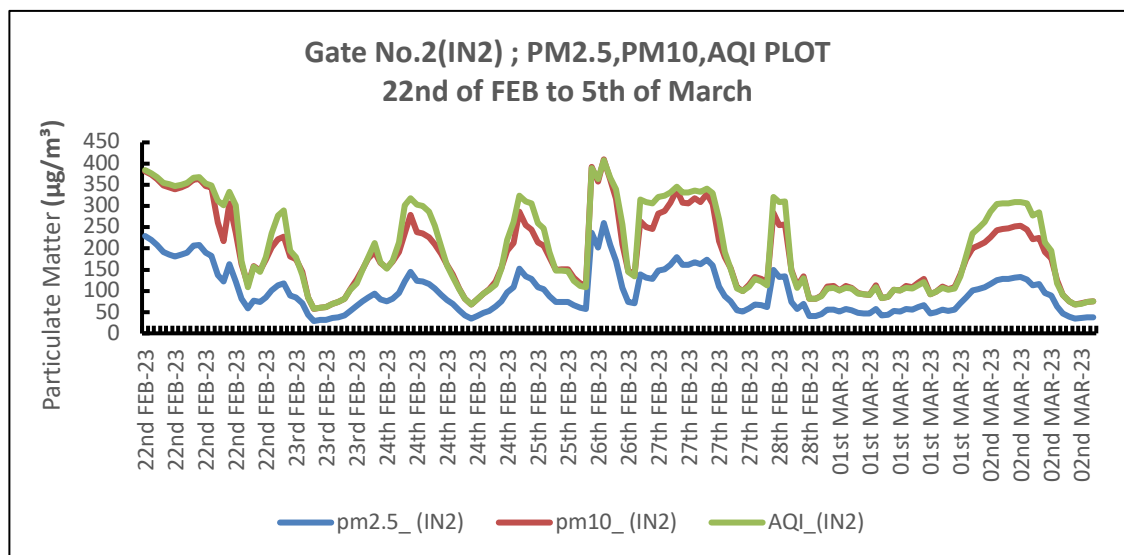


Figure 3. Daily average variations of PM2.5, PM10 and AQI at Gate no 2 from 22nd February to 5th March

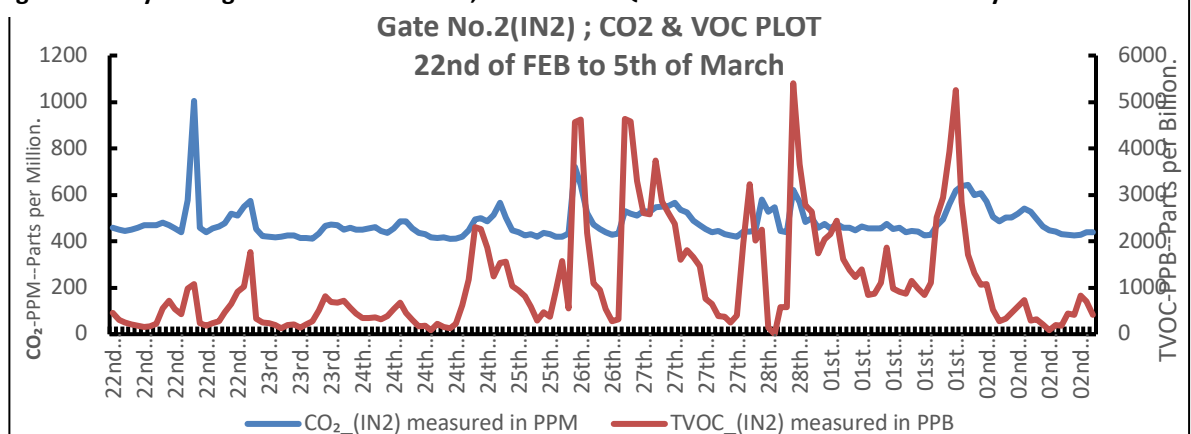


Figure 4. Daily average variations of CO2 and VOC at Gate no.2 from 22nd February to 5th March

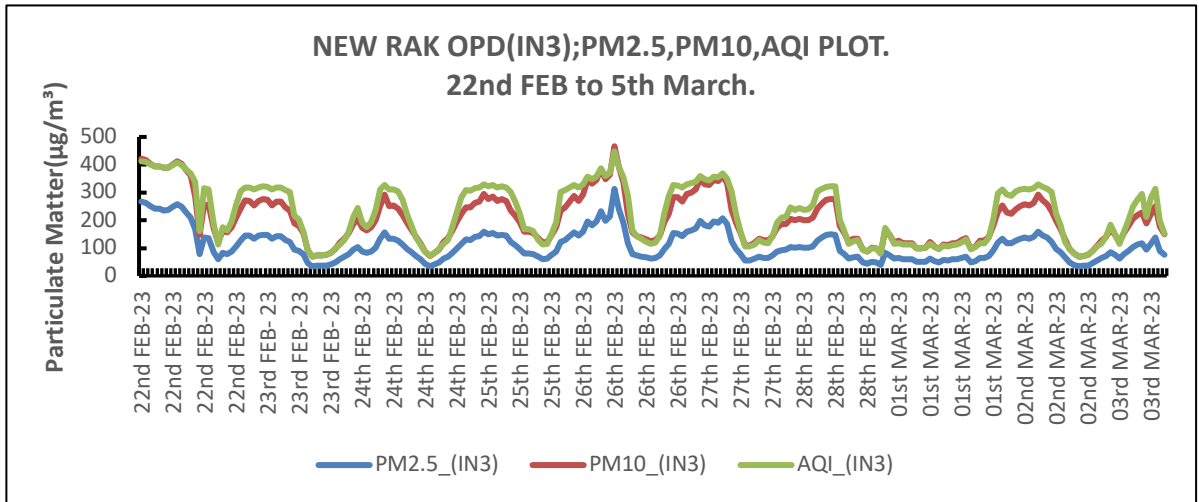


Figure 5. Daily average variations of PM2.5, PM10 and AQI at new RAK OPD from 22nd February to 5th March

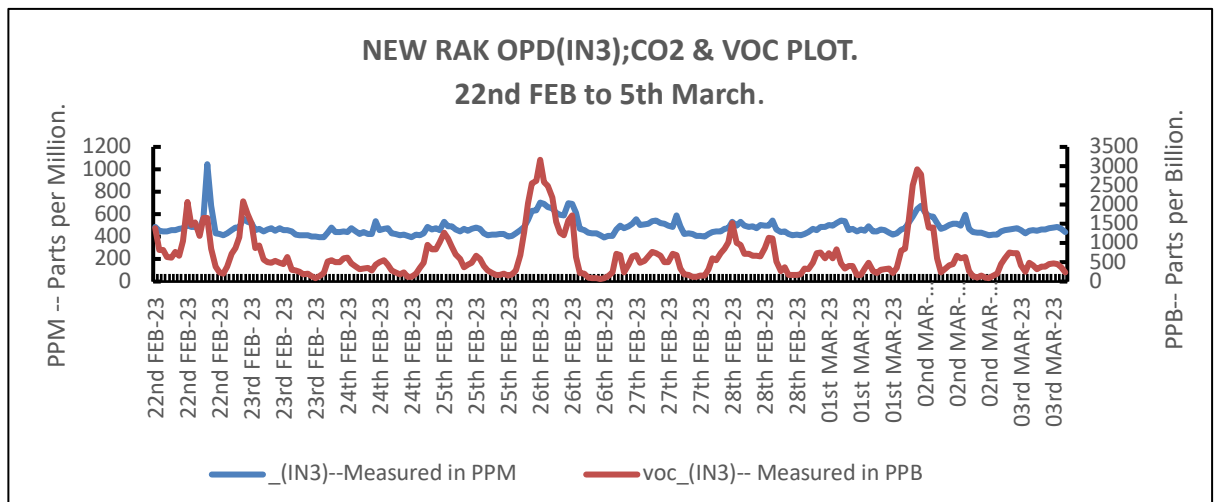


Figure 6. Daily average variations of CO2 and VOC at new RAK OPD from 22nd February to 5th March

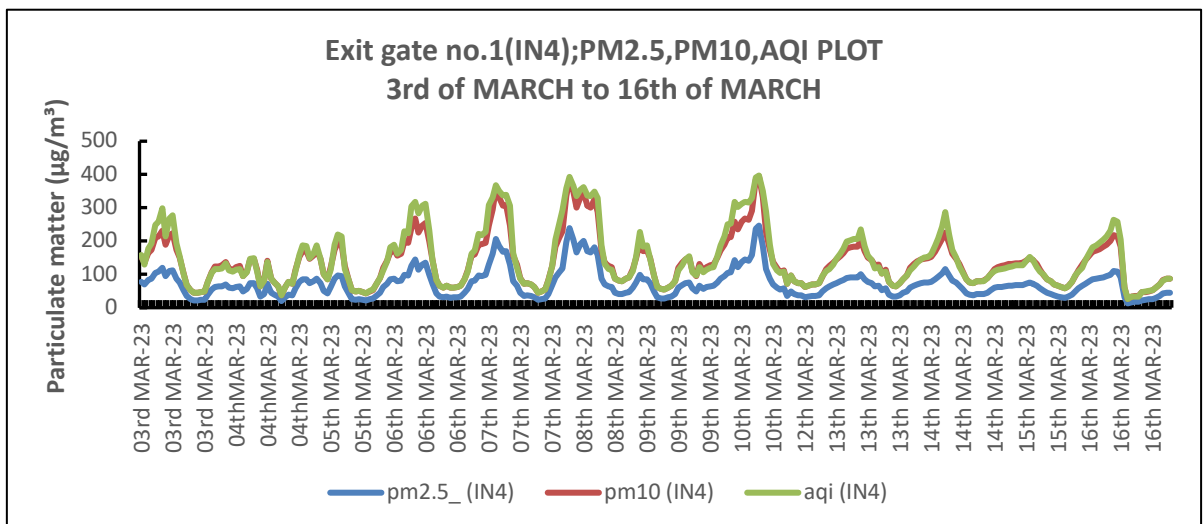


Figure 7. Daily average variations of PM2.5,PM10,AQI at Exit Gate 1 from 3rd March to 16th March

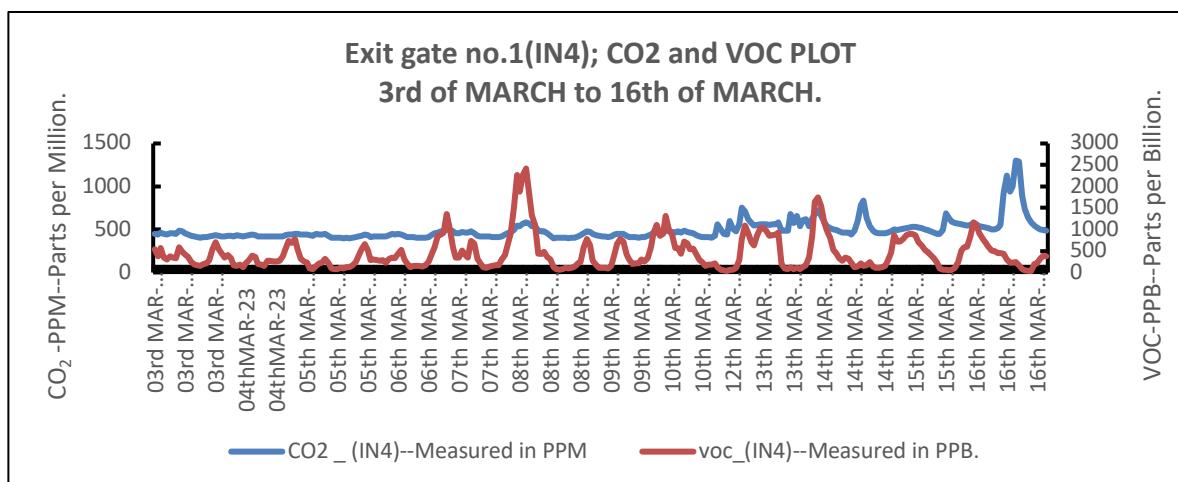


Figure 8. Daily average variations of CO2 and VOC at Exit Gate 1 from 3rd March to 16th March

4.1.2 Diurnal variation of pollutants :

- PM2.5 – The highest PM2.5 concentrations were found to be 151.3 $\mu\text{g}/\text{m}^3$, 163.75 $\mu\text{g}/\text{m}^3$ and 116.5 $\mu\text{g}/\text{m}^3$ during 7:00 am, 9:00 am, 8:00 am at Gate no.2, new RAK OPD and Exit Gate no 1 respectively. (Refer Fig 9,11 & 13)
- PM10 : The highest PM10 concentrations were found to be 278.6 $\mu\text{g}/\text{m}^3$, 285.9 $\mu\text{g}/\text{m}^3$ and 218.2 $\mu\text{g}/\text{m}^3$ during 7:00 am, 9:00 am, 8:00 am at Gate no.2, new RAK OPD and Exit Gate no 1 respectively. (Refer Fig 9,11 & 13)
- CO2: The highest CO2 concentrations were found to be 531.2 ppm, 535.2 ppm, 518.8 ppm during 7:00 am, 12:00 am, 1:00 pm at Gate no.2, new RAK OPD and Exit Gate no 1 respectively. (Refer Fig 10,12 & 14)
- TVOC: The highest TVOC concentrations were found to be 2405.8 ppb, 1319.1 ppb and 845.08 ppb during 10:00 pm, 12:00 am, 11:00 pm at Gate no.2, new RAK OPD and Exit Gate no 1 were respectively. (Refer Fig 10,12 & 14)

For diurnal variation of pollutants, PM 2.5 and PM10 peak concentrations can be seen during 9:00 am in morning whereas for CO2 and VOC the same is true for 12:00 am and 10:00 pm in night.

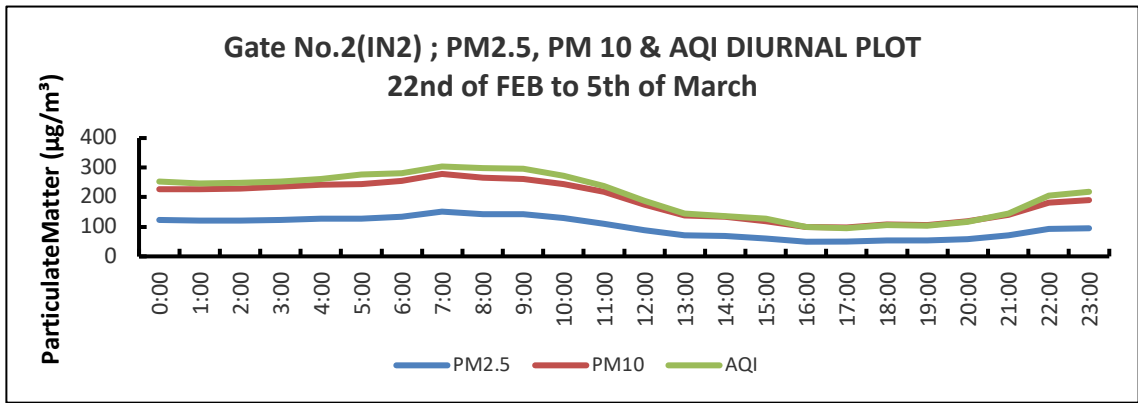


Figure 9. Daily diurnal variations of PM2.5,PM10,AQI at Gate no 2 from 22nd February to 5th March

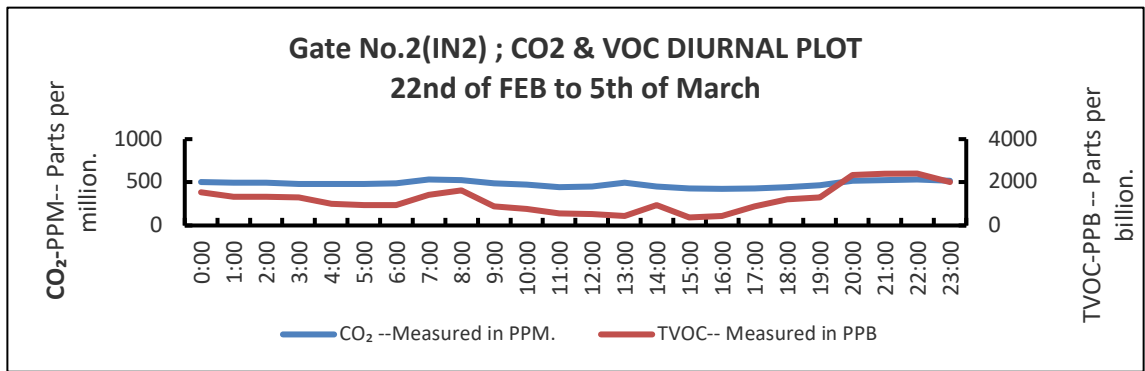


Figure 10. Daily diurnal variations of CO2 and VOC at Gate no 2 from 22nd February to 5th March

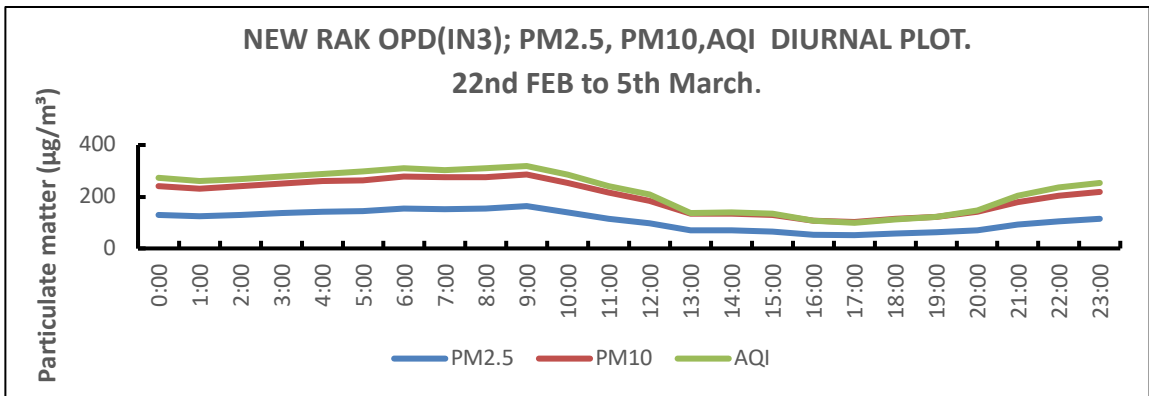


Figure 11. Daily diurnal variations of PM2.5,PM10,AQI at New RAK OPD from 22nd February to 5th

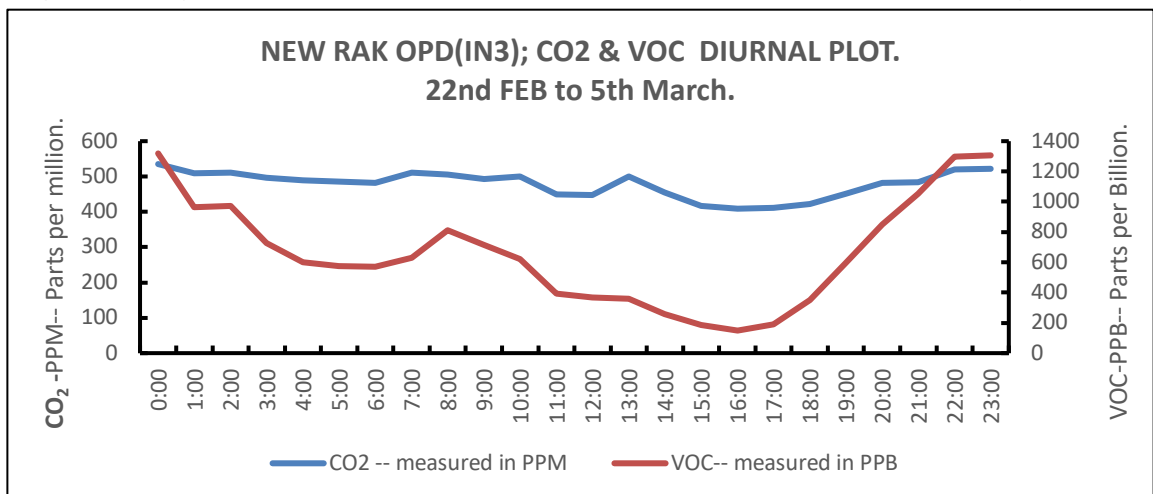


Figure 12. Daily diurnal variations of CO2 and VOC at New RAK OPD from 22nd February to 5th March

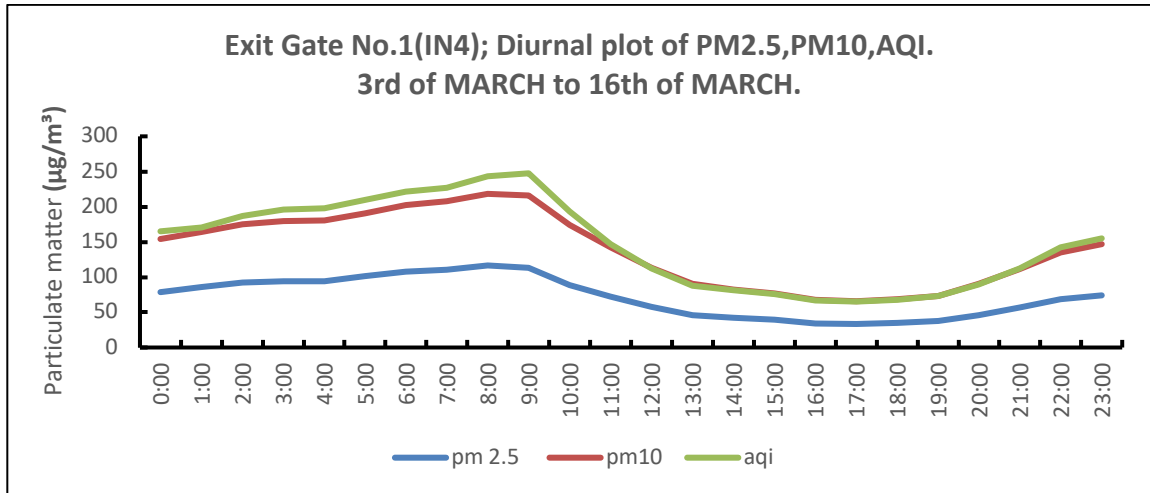


Figure 13. Daily diurnal variations PM2.5,PM10 and AQI at Exit Gate 1 from 3rd March to 16th March

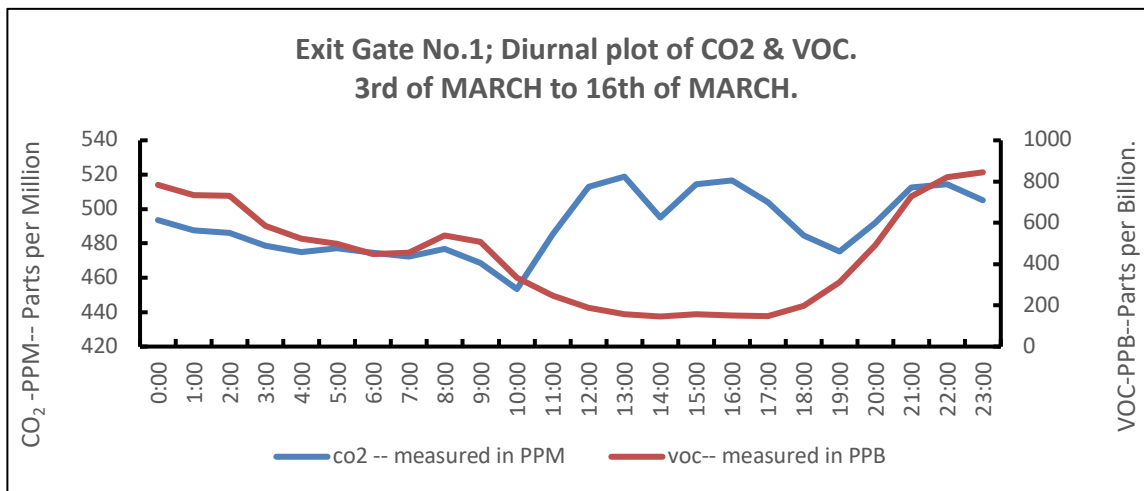


Figure 14. Daily diurnal variations of CO2 and VOC at Exit Gate 1 from 3rd March to 16th March

4.1.3 Air Quality Index(AQI): The highest AQI values at all the three outdoor locations (Gate no.2,new RAK OPD and Exit Gate no 1) were recorded as 408 ,448 and 397 at respectively. (Refer Fig 3,5 & 7) According to National Air Quality index given by CPCB ,the AQI is in “very poor” and “severe” category.

4.2 INDOOR LOCATIONS

4.2.1 Major pollutants:

- PM2.5 - The highest concentration of PM2.5 at Foyer area, B.B Dikshit library, Medicine ward and Old OT block were 134 $\mu\text{g}/\text{m}^3$,56 $\mu\text{g}/\text{m}^3$,122 $\mu\text{g}/\text{m}^3$ and 286.5 $\mu\text{g}/\text{m}^3$ respectively. (Refer Fig15,17 ,19 & 21)
- PM10 : The highest concentration of PM10 at Foyer area, B.B Dikshit library, Medicine ward and Old OT block were 255.5 $\mu\text{g}/\text{m}^3$,101 $\mu\text{g}/\text{m}^3$, 258.5 $\mu\text{g}/\text{m}^3$ and 433.5 $\mu\text{g}/\text{m}^3$ respectively. (Refer Fig15,17 ,19 &21)
- CO2: The highest concentration of CO2 at Foyer area, B.B Dikshit library, Medicine ward and Old OT block were 908.5ppm , 979 ppm, 1039.5ppm and 681 ppm respectively. (Refer Fig16,18, 20 & 22)
- TVOC: The highest concentration of TVOC at Foyer area, B.B Dikshit library, Medicine ward and Old OT block were 1983.5ppb ,1386ppb, 1922.5ppb and 2351ppb respectively. (Refer Fig16,18 ,20 & 22)

It can be seen that amongst all the indoor locations, the PM2.5 ,PM10 and VOC peak concentrations can be found at old OT block whereas for CO2 the same is true for Medicine ward.

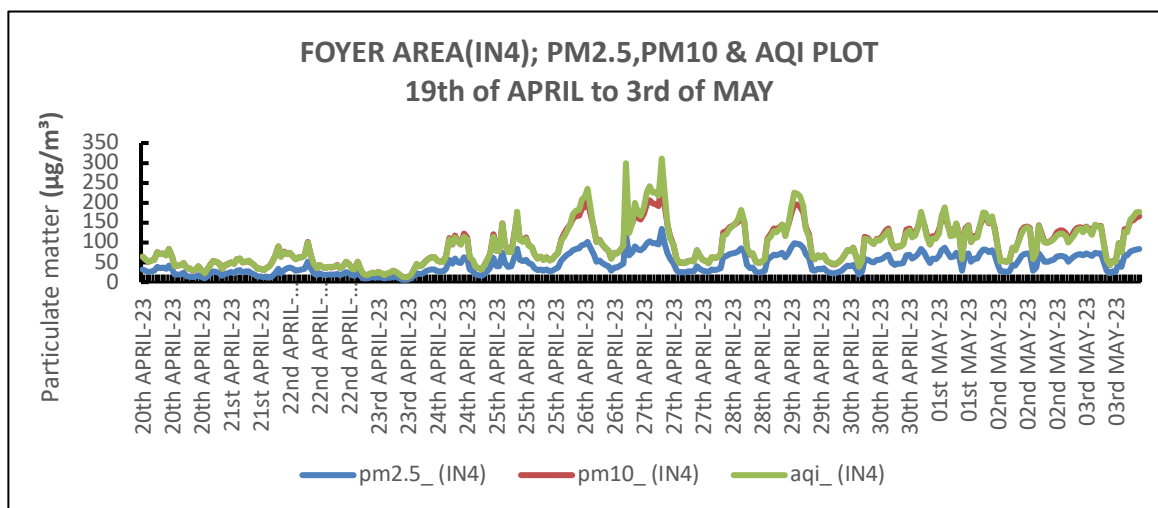


Figure 15. Daily average variations of PM2.5, PM10 and AQI at Foyer area from 19th April to 3rd May

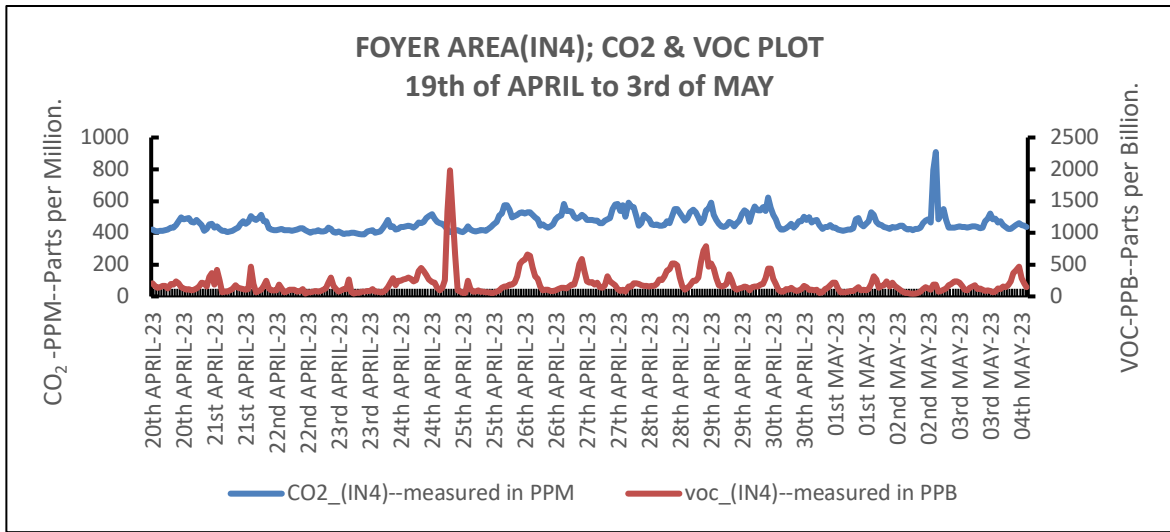


Figure 16. Daily average variations of CO2 & VOC at Foyer area from 19th April to 3rd May

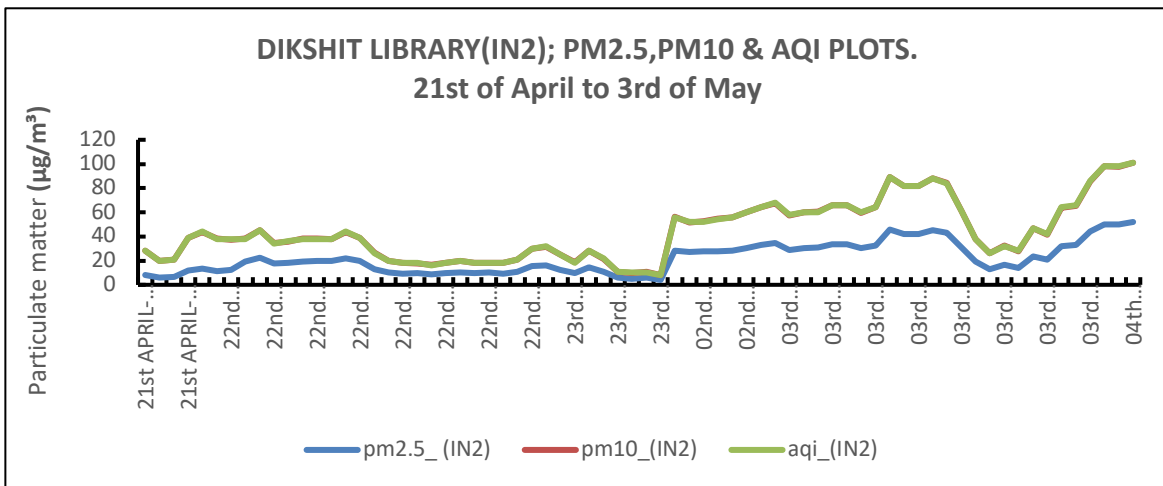


Figure 17. Daily average variations of PM2.5, PM10 and AQI at B.B.Dikshit library from 21st April to 3rd May

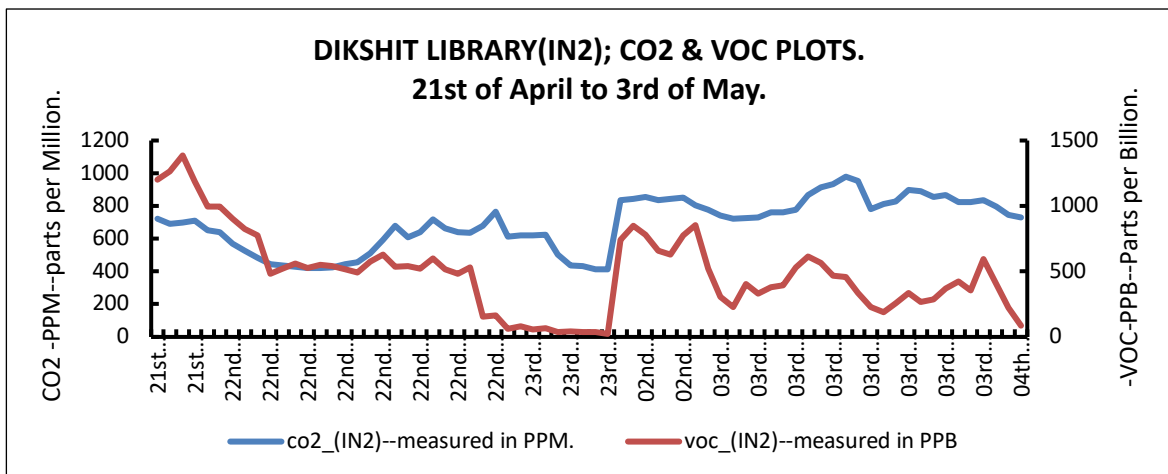


Figure 18. Daily average variations of CO2 and VOC at B.B.Dikshit library from 21st April to 3rd May

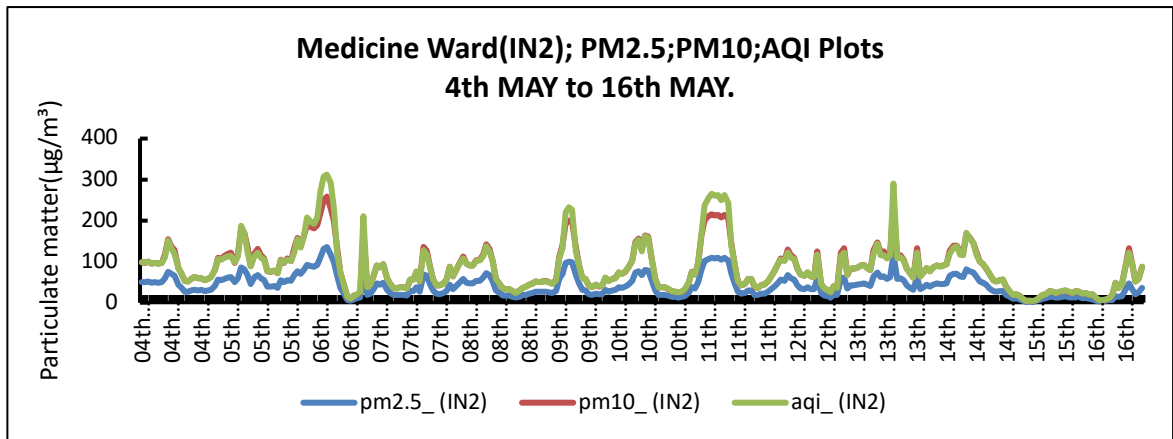


Figure 19. Daily average variations of PM2.5, PM10 and AQI at Medicine ward from 4th May to 16th May

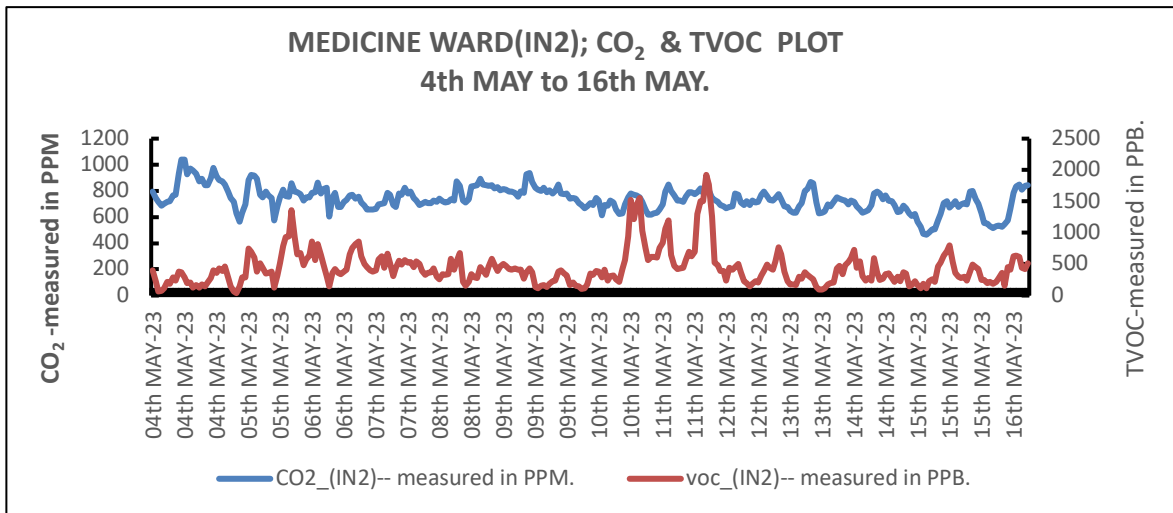


Figure 20. Daily average variations of CO2 & VOC at Medicine ward from 4th May to 16th May

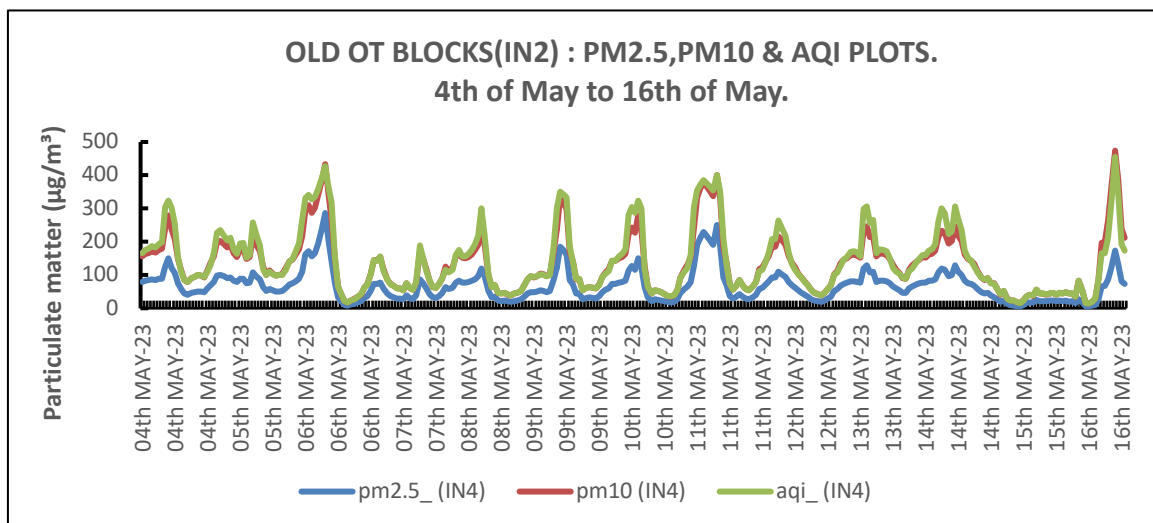


Figure 21. Daily average variations of PM2.5,PM10 and AQI at Old OT block from 4th May to 16th May

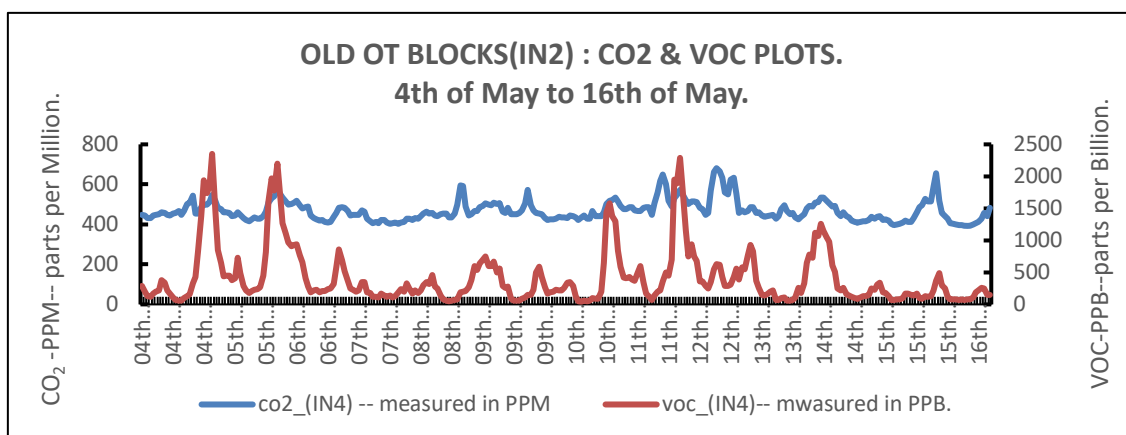


Figure 22. Daily average variations of CO₂ and VOC at Old OT block from 4th May to 16th May

4.2.2 Diurnal variation of pollutants:

- (a) PM_{2.5} : The highest PM_{2.5} concentrations were found to be 61.96 µg/m³, 37.5 µg/m³, 64.3 µg/m³ and 124.6 µg/m³ during 8:00 am, 2:00 am, 8:00 am and 8:00 am at Foyer area, B.B Dikshit library, Medicine ward and Old OT block respectively. (Refer Fig 23,25,27& 29)
- (b) PM₁₀ : The highest PM₁₀ concentrations were found to be 121.6 µg/m³, 73.7 µg/m³, 128.69 µg/m³ and 231.2 µg/m³ during 8:00am, 2:00am, 9:00am and 8:00am at Foyer area, B.B Dikshit library, Medicine ward and Old OT block respectively. (Refer Fig 23,25,27& 29)
- (c) CO₂: The highest CO₂ concentrations were found to be 513.6 ppm, 746 ppm, 830.15ppm and 505.7 ppm during 2:00 pm, 1:00 am, 10:00 am and 5:00pm at Foyer area, B.B Dikshit library, Medicine ward and Old OT block respectively. (Refer Fig 24,26,28 & 30)
- (d) TVOC: The highest TVOC concentrations were found to be 317.5ppb, 576.8ppb, 680.9ppb and 944.6 ppb during 8:00 pm, 2:00 am, 11:00 pm and 10:00pm at Foyer area, B.B Dikshit library, Medicine ward and Old OT block respectively. (Refer Fig 24,26,28 & 30)

For diurnal variation of pollutants, PM 2.5 and PM₁₀ peak concentrations can be seen during 8:00 am in morning whereas for CO₂ and VOC the same is true for 10:00 am and 10:00 pm in night.

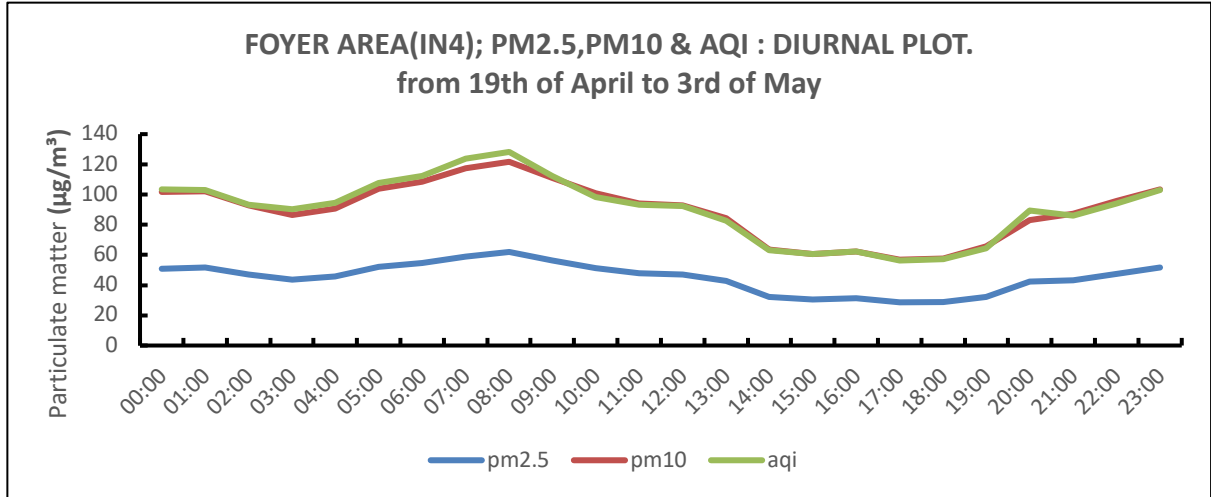


Figure 23. Daily diurnal variations of PM2.5, PM10 and AQI at Foyer area from 19th April to 3rd May

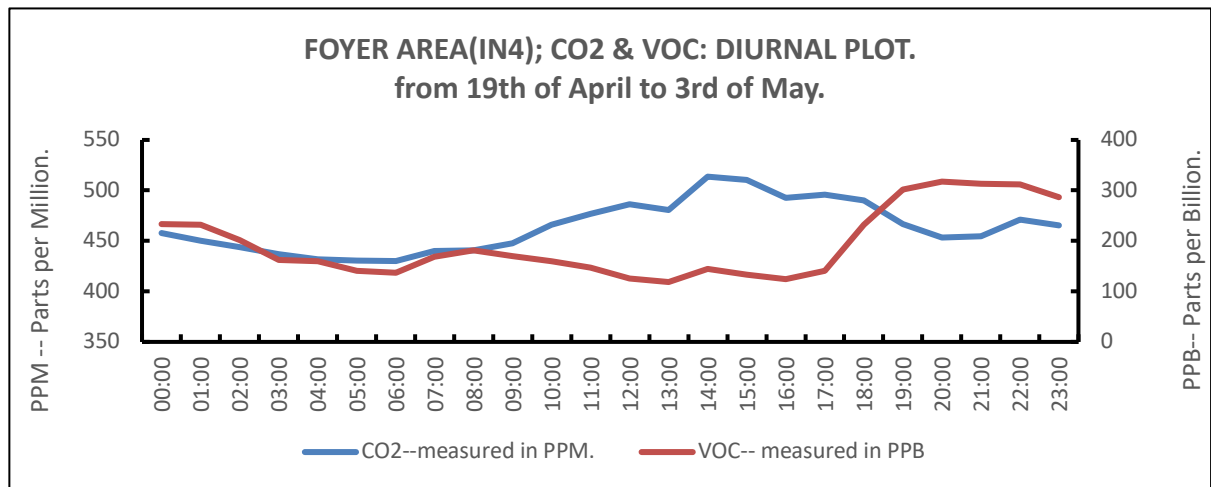


Figure 24. Daily diurnal variations of CO2 & VOC at Foyer area from 19th April to 3rd May

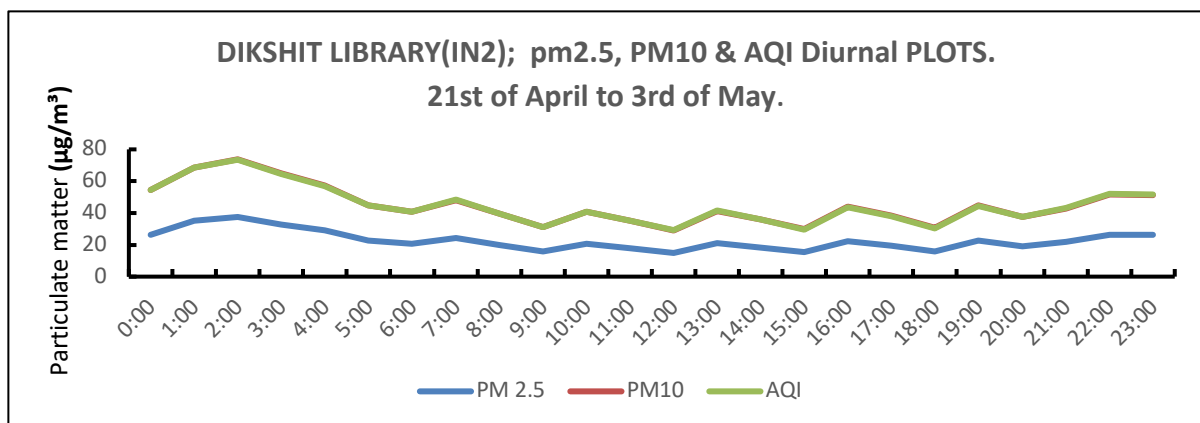


Figure 25. Daily diurnal variations of PM2.5, PM10 and AQI at B.B.Dikshit library from 21st April to 3rd May

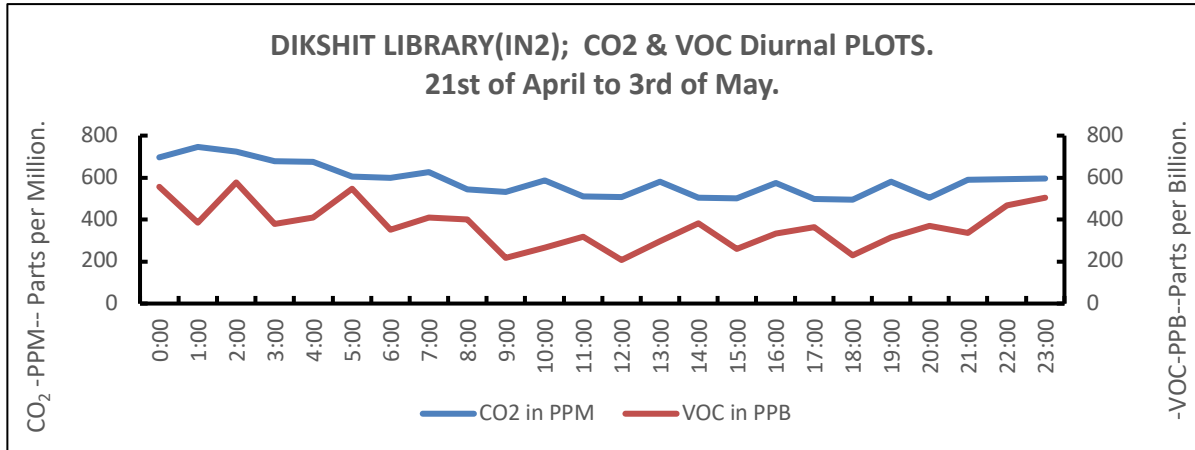


Figure 26. Daily diurnal variations of CO2 and VOC at B.B.Dikshit library from 21st April to 3rd May

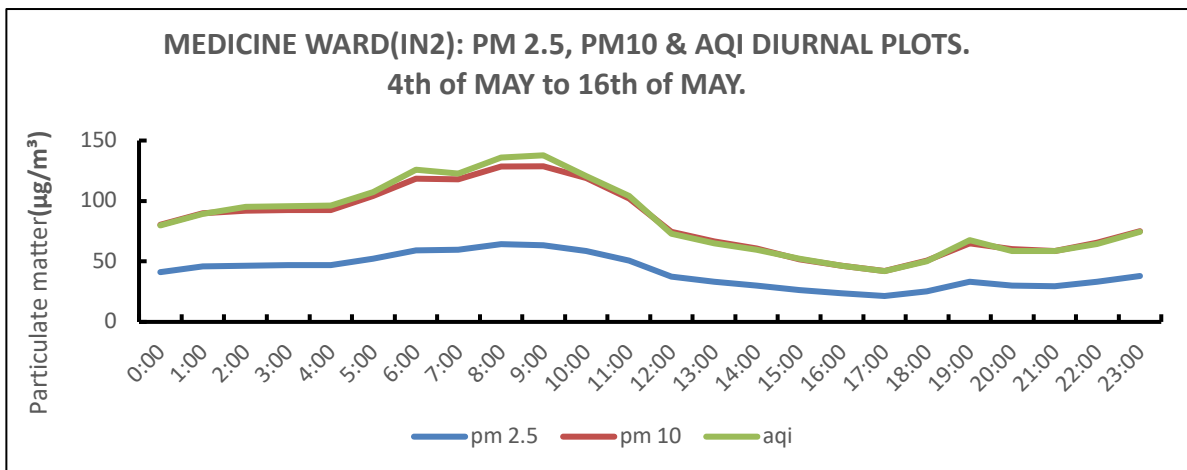


Figure 27. Daily diurnal variations of PM2.5, PM10 and AQI at Medicine ward from 4th May to 16th May

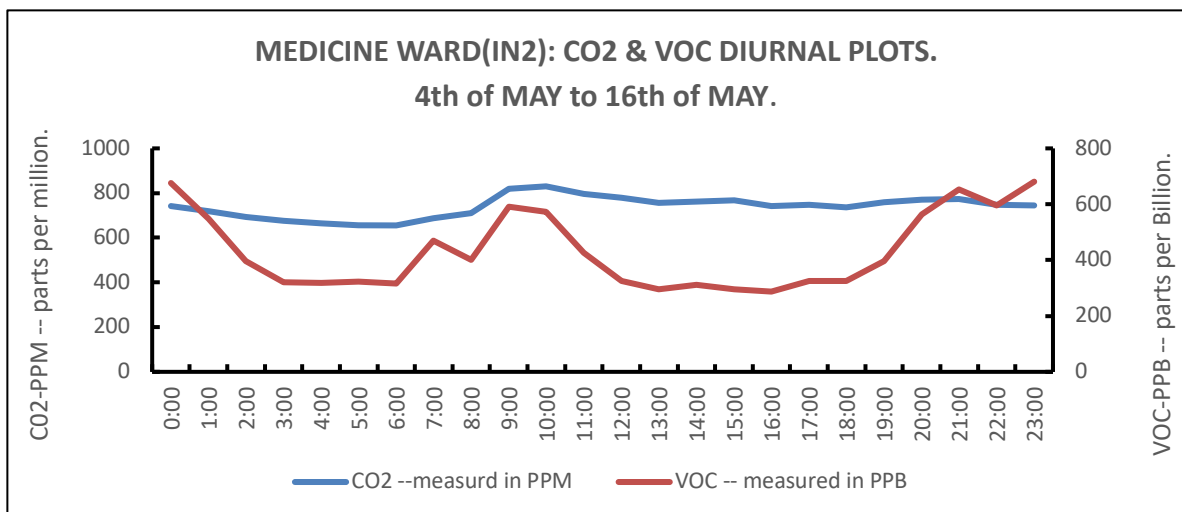


Figure 28. Daily diurnal variations of CO2 and VOC at Medicine ward from 4th May to 16th May

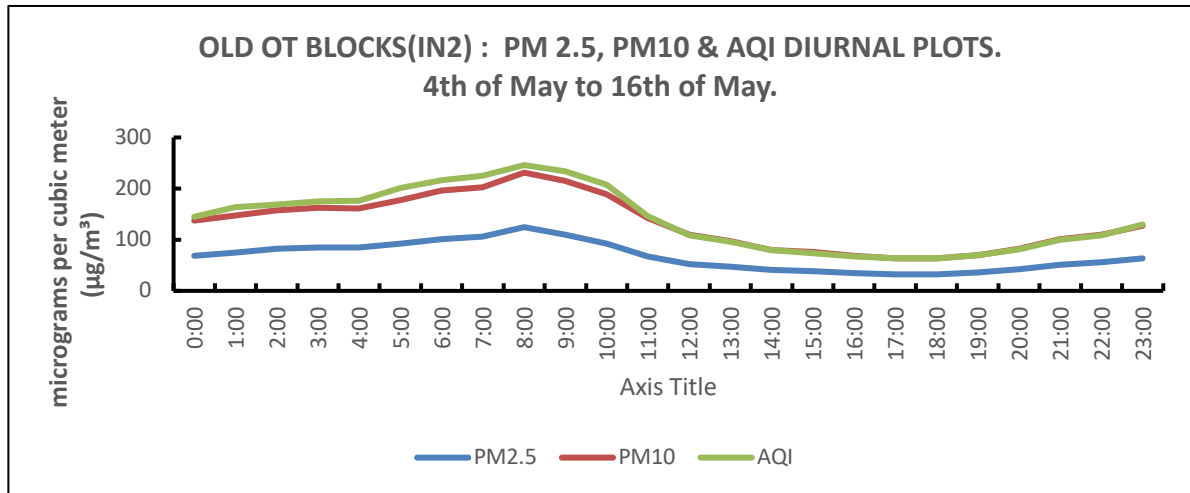


Figure 29. Daily diurnal variations of PM2.5, PM10 and AQI at Old OT block from 4th May to 16th May

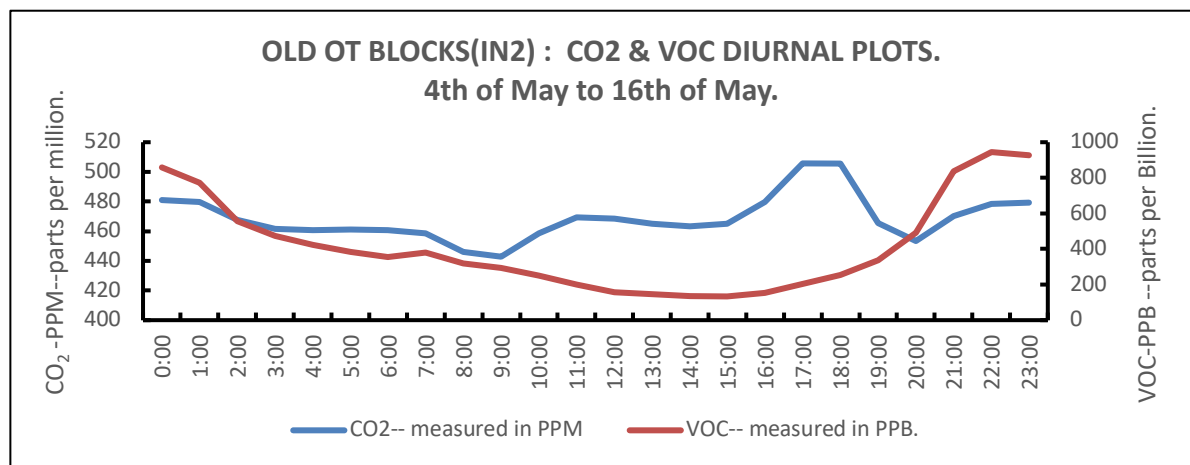


Figure 30. Daily diurnal variations of CO2 and VOC at Old OT block from 4th May to 16th May

4.2.3 **Air Quality Index-** The highest AQI values at all the four indoor locations (Foyer area, B.B Dikshit library, Medicine ward and Old OT block) were recorded as 311,101,312 and 455 respectively. (Refer Fig 15,17,19 & 21) According to National Air Quality Index given by CPCB,the AQI is in “very poor” and “severe” category for the remaining locations except for B.B.Dikshit library where it was in the “moderate” category.

5. Conclusion

In this initiative, the variation in the concentration of major air pollutants (PM_{2.5}, PM₁₀, CO₂ and VOC) across 7 locations (3 outdoor and 4 indoor) inside AIIMS campus is compared at daily intervals for the period of February – May ,2023. It can be concluded that PM_{2.5} and PM₁₀ values at all the locations inside the AIIMS campus were well above the National Ambient Air Quality standards (NAAQS).

6. Follow up assessment

The PM_{2.5} and PM₁₀ concentrations will be monitored again for gap of 6 months at the same locations to assess the impact of intra-institutional clean and green initiatives at AIIMS.

ANNEXURE

Office memorandum

**OFFICE OF THE DIRECTOR
ALL INDIA INSTITUTE OF MEDICAL SCIENCES
Ansari Nagar, New Delhi-110029**

F. No.40-30/2022-Estt.-I(DO)

Dated: 17th February, 2023

OFFICE MEMORANDUM

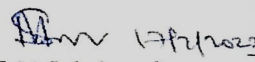
Subject: Monitoring of Air quality inside AIIMS, New Delhi Hospital campus.

With reference to the meeting with Collaborative for Air Pollution and Health Effects Research in India (CAPHER-India) on 31.01.2023, It has been decided that activity of monitoring of Air Quality in AIIMS Hospital campus will be done. Dr. Harshal Ramesh Salve, Additional Professor, Centre for Community Medicine and Co-Ordinator CAPHER India shall co-ordinate this activity in collaboration with Indian Institute of Technology, Delhi. Pollution monitoring low cost portable Censors will be placed at the strategic locations for monitoring of air quality. Possible locations for installations of sensors could be:

- (i) At Gate no.1
- (ii) At Emergency Medicine 1 (EM 1)
- (iii) At Gate no.2 entry junction
- (iv) At new Rajkumari Amrit Kaur (RAK) OPD
- (v) Near Gate no.3 road junction

Engineering Service Department and concerned Security Officers shall help to install and maintain the monitors at the defined locations. This will help us to assess the impact of initiatives taken under Clean and Green AIIMS in future.

Detailed Plan of the activity will be submitted by the Dr. Harshal Ramesh Salve to the undersigned within 15 days.


(Prof. M Srinivas)
Director

Distribution:

- Additional Director (Administration)
- Dr. Harshal Ramesh Salve
- The Superintending Engineer
- Chief Security Officer
- Professor incharge, Computer Facility
- Sr. Financial Advisor
- Deputy Secretary