

# Analysis of Electromagnetic Radiations in Environment

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## ABSTRACT

The continuous development in the Telecom industry has changed our way of life. It has never been so convenient and easy before to do the things as it has been today with the mobile telecom industry that has reached its heights. But as the technology advances the need for more speed, more coverage area etc are the requirements that the telecom operators try to meet. With that more and more high power mobile base stations are installed that in turn has raised the electromagnetic radiation levels in our environment. The issues concerning the interaction of radiations with the human health has also raised concerns that if the uninterrupted exposure to these are safe or not. The goal of this study was to analyse the intensity levels of the electromagnetic radiations in the environment of different sites in Chandigarh and checking if the radiation intensity levels satisfy the norms that have been adopted by Government of India or not and also to compare these intensities to the various biological limits.

**Keywords :** Radiations, Electromagnetic Field Intensity, Base Station, Analysis.

## I. INTRODUCTION

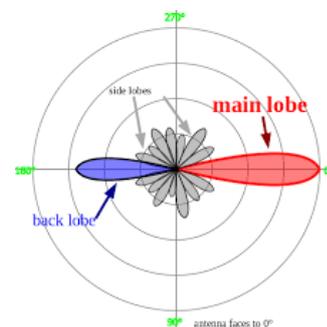
With the advancements in the modern science and technology there has been a rapid improvement in telecom industry. The situation has changed completely from past decade with evolution of 2G, 3G and now a days the 4G. The shift from the first generation to fourth generation has been due to the increased capacity and the demand for more speed and a strong coverage area. There have been various studies and reports that revealed these radiations are a health concern. As the people have become more and more health conscious, many people believe that the radiations have direct impacts on health. On the other hand telecom operators have also faced many problems like damage to communication equipments like base stations that has resulted in the demolition of base station or sometimes giving up the construction halfway. Studies show an increased risk of brain tumour and acoustic neuronal due to the radiations [1][2]. Studies have shown the effects on cognitive function [3], eyes [4] and even on animals and birds [5].

This article has taken basis as the field measurements data to analyse the electromagnetic environment. Number of different sites in Chandigarh were chosen to observe the electromagnetic power due to radiations at

these sites. The different sites chosen were the PEC University of Technology, Timber market, Police line, Governor House, and a terrace with multiple antennas.

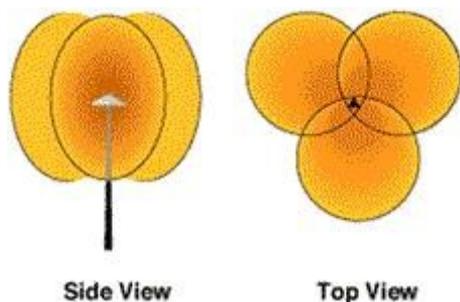
## II. TEST OBJECT FOR ELECTROMAGNETIC ENVIRONMENT

Test object is the directional antenna that is most commonly used. The picture below shows the graphical view of horizontal pattern of the directional antenna. The signal diffuses outwards as a main lobe and then the signal gradually weakens. Most of the signal strength is in the main lobe.



Generally each base station has three sectors. Each sector is governed by single or multiple antennas and each sector covers a certain range of distance. Each antenna transmits the signal and simultaneously it

receives the signal. The pattern below shows the top view and the side view of the signal from three sectors of distribution.



The downward inclination of each antenna is directly proportional to its height above the ground level where it is mounted and inversely proportional to its radius.

### III. TEST EQUIPMENT AND TEST METHOD

Cornet ED78S was used in measuring the field intensities. Cornet is the company that makes the ED78S electro smog meter.

Cornet is the company that manufactures ED78s radiation measuring instrument. The instrument is equipped with measuring electric field, magnetic field and power intensity. The frequency range of the instrument varies from 100 KHz to 3GHz.

The test object is mainly the directional antenna which is most frequently used in the mobile communication. The signal diffuses outward after being given out from antenna, and gradually weakens. When implementing the field test, the site selection for the test point should be within the antenna radiation range, avoiding the building blocking out direction as far as possible. Trying to avoid the interference with the influence on the test possibly produced by high voltage cable, electromotor, metal rack, advertising board etc. The specific location should be taken as priority near the antenna where public can reach. A height of 1.7 m was maintained with probe pointing towards the test site. A mode of maximum average value was adopted and samples were taken at an interval of 15 seconds.

### IV. TEST RESULTS AND ANALYSIS

#### A. Radiation intensity in PEC University of technology, electronics department

The Results obtained in the electronics department taking all the four floors (taking Five samples at a time interval of 10-15 seconds and units as  $mW/m^2$ ) are as following:

TABLE 1. MEAN VALUE OF SAMPLES AT DIFFERENT FLOORS OF THE SITE

Location	Average of all the samples ( $mW/m^2$ )
Ground Floor	0.0051
First floor	0.00544
Second floor	0.0209
Top floor	0.0126

The readings show variations between 0.0018 to 0.048  $mW/m^2$ . Observations on the ground floor showed variations between 0.0018 to 0.0083  $mW/m^2$ . Readings on the first floor were almost identical to the ground floor with minimum and maximum observation being 0.0028  $mW/m^2$  and 0.0095  $mW/m^2$ . There exist an antenna on the top floor of the department. But it was observed that the reading of ground and first floor were not so high and neither there were any significant difference, but the top floor and the second floor showed a high intensity of readings. Another point that inferred from the observations is that the second floor showed relatively higher values varying from 0.0028  $mW/m^2$  to 0.0283  $mW/m^2$ , than the top floor where the readings observed were between 0.0083  $mW/m^2$  to 0.0139  $mW/m^2$ , it is due to the fact that the antennas are tilted a bit towards the ground at angle proportional to its height and radius.

#### B. Radiations intensities at different locations in Chandigarh

Five different locations were chosen in Chandigarh to see the radiations intensities at different location in Chandigarh. The locations selected were Governor House, timber market, police line, near PEC and a terrace with multiple antennas around. Five samples were taken at each location at an interval of 10-15 seconds. The site near PEC University of Technology showed the variations between 0.469 to 0.816  $mW/m^2$ . A densely populated area Timber market was observed

to see if the base stations are provided with higher power levels to compensate the traffic demand. The reading observed there were between 0.312 to 0.889 mW/m<sup>2</sup>. Site with multiple antennas was chosen to see power levels showing cumulative reading due to multiple operators at single site. The levels observed at this locations were relatively the highest. The readings were observed between 0.783 to 1.48 mW/m<sup>2</sup>. Table 2 shows the average readings of all the samples at different locations

TABLE 2. MEAN VALUE OF ALL THE SAMPLES AT EACH LOCATION

Location	Intensity of radiation(taking average) (mW/m <sup>2</sup> )
Near PEC	0.6112
Governor House	0.284
Timber market	0.187
Police line	0.356
Terrace with multiple antennas around	1.48

The readings show variations between 0.0496 to 1.48 mW/m<sup>2</sup>. Observations were least near by the Governor house and highest on the terrace with multiple antennas. The readings in a populated area like timber market were not so significantly high compared to the observation on the terrace where more than one antenna exist. This is due to the reason that the continuous reception and transmission of signals on both antennas show a cumulative reading .

In India till 2013 we adopted radiation norms given by ICNIRP guidelines of 1998 for safe power density. But in 2013 norms in India were revised, which came into effect from August 2013. India adopted strict limits for radiations, which is 1/10<sup>th</sup> of norms defined by International commission on non-ionizing radiation protection (ICNIRP) (Department of Telecommunication,2013)[6][8]. The new norm set was 0.92 W/m<sup>2</sup>.

Now in the results it has been observed that the measured power density readings for different sites were well within the limit prescribed by Department of Telecommunications, India, but these values fall under the category of severe concern in biological limits(10 - 1000 μW/m<sup>2</sup> -severe concern)[8].

## V. CONCLUSION

Nowadays, there is an ever growing advancement in science and technology. With this advancement the issues related to the radiations are also escalating because of their harmful effect on human health. There is a seriously emerging health risk that is likely to get worsen until regulations restricting over exposure to electromagnetic pollutants are enforced.

Through the data analyses it was found that the electromagnetic radiation levels at different sites have following characteristics:

1. The pitching of antenna at an angle tilting towards the ground has a great impact on magnitude of electromagnetic radiation.
2. In order to have a larger coverage area operators provides the base station with high power while there is a need to have more number of base stations provided with lower power that can satisfy the need of the traffic.
3. When there exist a multiple antennas at single site the magnitude of radiation intensity cumulates due to the multiple antennas. Multiple operators at a single site having the requirement of signal in the same direction leads to superposition of powers from all the antennas and this situation may exceed the norms.

## VI. REFERENCES

- [1] H.C. Christensen, J. Schuz, M. Kosteljanetz, H.S. Poulsen, J. Thomsen, and C. Johansen, "Cellular telephone use and risk of acoustic neuroma, Am. J". *Epidemiology*, 159, 2004, 277–283..
- [2] JE. Muscat , "Handheld Cellular Telephone use and Risk of Brain Cancer", *JAM, the journal of the American Medical Association*, 23, 2000, 3001-3007.
- [3] M.Koivisto, A. Revonsvo, C. Krause, C. Haarola, L. Sillanmaki, M.Laine, and H. Hamalainen, *Effects of 902 MHz Electromagnetic Fields Emitted by Cellular Telephones on Response Times in Humans, Neuroreport*, 11, 2000, 413-415
- [4] Sheerup Goswami, *Polluting rays strike out, Science Reporter*, 2010.

- [5] Singh, L., Mahajan, R. and Bagai, D., *RADIATIONS AND DIRTY ELECTRICITY AFFECTING HUMAN HEALTH*, 9, January 2017, 34-36
- [6] Department of telecom, "Journey-emf", August 2013
- [7] ICNIRP GUIDELINES, "for limiting exposure to time-varying electric, magnetic and electromagnetic fields (up to 300 ghz).
- [8] Department of biology, "BUILDING BIOLOGY EVALUATION GUIDELINES", *Institut für Baubiologie, Germany*, 2008