Retraction

Retraction: Construction Emission Management using Wind Rose Plot and AERMOD Application (IOP Conf. Ser.: Mater. Sci. Eng. 1145 012106)

Published 23 February 2022

This article (and all articles in the proceedings volume relating to the same conference) has been retracted by IOP Publishing following an extensive investigation in line with the COPE guidelines. This investigation has uncovered evidence of systematic manipulation of the publication process and considerable citation manipulation.

IOP Publishing respectfully requests that readers consider all work within this volume potentially unreliable, as the volume has not been through a credible peer review process.

IOP Publishing regrets that our usual quality checks did not identify these issues before publication, and have since put additional measures in place to try to prevent these issues from reoccurring. IOP Publishing wishes to credit anonymous whistleblowers and the Problematic Paper Screener [1] for bringing some of the above issues to our attention, prompting us to investigate further.

[1] Cabanac G, Labbé C and Magazinov A 2021 arXiv:2107.06751v1

Retraction published: 23 February 2022
Construction Emission Management using Wind Rose Plot and AERMOD Application

R Gopi1, R Saravanakumar2, K S Elango3, A Chandrasekar4, K S Navaneethan4 and N Gopal5

1 Associate Professor, Department of Civil Engineering, Marri Laxman Reddy Institute of Technology and Management, Hyderabad, India
2 Assistant Professor, Department of Civil Engineering, KPR Institute of Engineering and Technology, Coimbatore, India
3 Assistant Professor, Department of Civil Engineering, PSNA College of Engineering and Technology, Dindigul, India
4 Assistant Professor, Department of Civil Engineering, Kongu Engineering College, Perundurai, India
5 PG Student, Department of Civil Engineering, KPR Institute of Engineering and Technology, Coimbatore, India
kselango04@gmail.com

Abstract. Construction activities have the potential to generate a substantial amount of air pollution. In the past 30 years pollution in construction industry has acknowledged more consideration in the industry. Dust and emissions from destruction and construction activities can worsen the quality of air which can harm to health and impact upon life quality. Particulate matter PM10 and PM2.5 (less than 10 mm, 2.5 mm in Φ) are now recognized as significant causes of pollution and they can be carried from sites even in light winds. India is home to 13 of the 20 cities with the maximum levels of particulate air pollution worldwide, according to 2012 statement by the World Health Organization. This paper provides an overview of control of dust emissions by considering the direction and dispersion of particulate emissions based on wind speed. Indian Meteorological Data (IMD) provides a details regarding wind speed for every location which can be taken into account. It is necessary to maintain the air quality according to Central Pollution Control Board (CPCB).

1. Introduction

It has been done in the past to create concrete structures that are vibration-free. However, the concrete describes construction by its nature is hazardous and can generate enormous amount of air pollution. Dust refers to all airborne particulate matter (PM) that is, solid particles that are pendant in air or have settled down onto a surface. Dust can turn into airborne when material is bare or left uncovered. Wind then picks up the bare dust particle and taken it off-site. The most conventional ways that soil is bare comprise demolition activities, site training activities, construction activities, vehicle transportation and uncovered stockpiles. It causes potential effect on peoples, environmental resources, air quality, affect natural water conservation and cultural heritage. The control of pollution in construction sector is the manage of all individual performance that have an also important or minute unenthusiastic shock.
on the surroundings for all over building procedure [1]. Particle pollution also expressed as "Particulate matter" or PM, is a multifaceted combination of very tiny particles in addition to fluid particles pendant inside the atmosphere. Normally used pointers telling PM are pertinent to physical condition indicate to the collection attentiveness of particles with a Φ of fewer than 10μm (PM10) and of elements having Φ of less than 2.5μm (PM2.5). PM2.5 called fine PM, also contain ultrafine elements with a Φ of fewer than 0.1μm. PM between 0.1μm and 1μm in Φ can stay in the environment for days and thus be applicable to extended range trans boundary movement in the air. PM is a mixture with physical and chemical characteristics varying by location. General chemical ingredients of PM comprise of chemicals, organic and elemental carbon, particle-bound water, crustal material and metals. Biological components such as allergens and microbial compounds are present in PM. The need of this present study is to enhance the knowledge level and project participants’ awareness, particularly project manager in regard of environmental impacts of construction processes needs to be enriched. Health consequences of air pollution from particulate matter and their implication for policymakers, with the aim of inspiring the progress of more effective strategies to decrease and also to recognize the regularity and harshness of environmental impact sourced by construction procedure in residential buildings and its policy to control emissions [2]. This study identifies the source of pollution and vulnerability from construction area, To categories, analyze and quantify the type of pollutants at construction site, To determine the incidence of winds blowing from specified paths over a particular time using WR PLOT with IMD, To determine the direction and dispersion of air pollution using AERMOD, To adopt suitable control measures according to direction and dispersion of particulate emissions.

2. Methodology

Though it is difficult to calculate the hazard hi generated by a particular construction operation, the process can be carried out based on expert’s opinion or by collecting secondary data’s. For the collection of secondary data’s activities which may cause enormous amount of dust pollution can be taken into account. It may include demolition, site clearance, burning category, excavation, material mixing, vehicle engine exhaust, foundation, super foundation, roof, painting, wood work etc. The data’s are analyzed and are shortlisted according to the hierarchy order. Likewise wind speed corresponding to particular location (Salem) should be taken into account. It could be collected from Indian Meteorological Data (IMD). At an initial step it is essential to analyze the frequency of wind speed blowing in particular direction using WR PLOT. It will provide us the pictorial representation of wind blown over specific period [3-5]. Then the next step involves determining the direction and dispersion of particular emissions using AERMOD. The magnitude of hazard hi corresponding to the particular activity and their corresponding wind speed should be taken as input. It will helps to enhance the way of reducing the particulate emissions by analyzing how long the dispersion will takes place.

3. Health Effects due to Particulate Emissions

PM10 and 2.5 comprise of substances that are little sufficient to enter the thoracic area of the respiratory track. The majority of dust substances cause respiratory problems and settled above vehicles. The physical condition consequences of inhalable PM are well recognized because of contact x in cooperation the short period (hours, days) and long period (months, years) and include Eye, Nose and Throat Irritation, Respiratory and Lung Disease Including Asthma problem, Pulmonary cancer (caused by carcinogen chemical through inhalation), Mesothelioma, Lungs mal function, Chronic obstructive pulmonary disease (COPD), Pneumonia, Leukemia (Blood cancer), Cardiovascular problems, heart disease, Stroke, Neurobehavioral disorder, Liver and other type of cancer. A technique for calculating building contamination is called Construction Pollution Index (CPI) and mentioned in Equation 1, Chen et al. (2000)

\[ CPI = \Sigma CPI_i = \Sigma h_i D_i \]  

Equation 1
Where, $h_i$ - Magnitude of hazard per unit of time produced by a precise operation $i$
$D_i$ - Duration of the operation in construction
CPI - Construction Pollution Index
$CPI_i$ - Construction Pollution Index, $i$
n - Number of construction operations that generate pollution and hazards.

In the above equation, limitation $h_i$ is a comparative parameter showing the magnitude of risk created by a particular construction process in a particular occasion. It is limited in the range of 0.1. Though it is difficult to measure value of $h_i$ involving different activities, it has to be found by knowledge, experience and specialist opinions.

4. Climatological Aspects

Climate poses a palpable trouble for construction sector. This is specifically evident during the stage of dry, windy weather when the probability of dust being taken up and blown about is amplified. As weather cannot be controlled, three things can be done to lessen climate-generated dust problems such as Inspect weather reports daily; closely scrutinize weather patterns to allow action to be taken instantly if conditions changes, Execute control actions that ensure dust problems do not happen while the construction site is unattended, eg. at night or weekends and Implement a site ‘shut down and cover up’ strategy during periods of intense weather situations, eg. High winds and low humidity. All site operations should cease and all uncovered areas enclosed or treated to ensure dust does not become airborne.

5. National Ambient Air Quality Standards

The National Ambient Air Quality Standards (NAAQS) recognized by the Environmental Protection Agency (EPA), UN under authority of the Clean Air Act that relate for outside air all over the country. NEPM also termed towards cities and town’s standard for dusts is framed by National Environment Protection Measure for Particulate Matter (PM). It is also followed by the agency Department of Environmental Regulation. This agency will monitor the contamination in the air across the cities. Besides, as per CPCB PM 10 and PM 2.5 concentration is represented in Table 1.

| Pollutants | Time Weighted Average | Ambient Air concentration as per CPCB |
|------------|-----------------------|---------------------------------------|
|            |                       | Industrial, Residential, Rural and other Areas | Ecologically Sensitive Area |
| PM10 (less than 10μm),μg/m$^3$ | Annual | 60 | 60 |
|            | 24 Hours             | 100 | 100 |
| PM2.5 (less than 2.5μm),μg/m$^3$ | Annual | 40 | 40 |
|            | 24 Hours             | 60 | 60 |

6. Wind Rose Plot

For collecting, analyzing and evaluating the air quality proper and reliable air quality management program requires. Moreover, it is essential to identify the drifts in quality of air so that control measure can be synchronized so. Pollution in air is the practice differ in time and space based on their movement, spreading, removal, etc. hence, it is needed to know the method in different scales according to meteorological features. Wind Rose diagrams signify the two-way joint frequency distribution of wind path and any other parameter under consideration. This will give a detail about a brief view about wind speed and path distribution at specified location. Wind frequency over a occasion phase is represented by wind path, by showing colour bands representing wind speed ranges
through polar coordinate system of gridding. The greatest spoke path demonstrates the wind route with the greatest frequency. It is obtainable in a spherical arrangement. The current wind rose demonstrates the wind blowing frequency from specific directions over a particular stage. A typical wind rose plot shown in Figure1. Sixteen cordial directions will be used in wind roses as like North, North East etc., although they have 32 direction subdivisions. As per measurement of angles (in degree), North corresponds to 0°/360°, East to 90°, South to 180° and West to 270°. Fig 1 shows the graphic representation of WR plot view. The distance end to end of every "spoke" about the loop is directly related to the frequency of wind blow from a specific direction per unit time. Every concentric circle signifies a dissimilar frequency, originating from zero at the middle to growing at the outer. A wind rose diagram may hold supplementary data, in that every spoke is wrecked into colour-coded bands that demonstrate wind speed series.

![Figure 1. Wind Rose Plot](image)

7. WR Plot View for Salem Station

According to Indian Metrological Data (IMD), wind speed corresponding to the station was collected and is given as input to perform WR PLOT. It will provide the pictorial representation of wind speed and the span of every "spoke" around the circle is associated to the frequency that the wind blows from a specified path per unit time. From the fig below it is noted that average wind speed is maximum of 18% in the direction of NE & SW which represents the particulate emissions would be more in that directions, So that extra precautions to be provided while working in that direction of maximum wind speed.

8. Summary

Though the construction activity has greater potential to generate particulate emissions, it can be controlled by proper planning. The activities responsible for tremendous release of dust emissions have been considered through detailed analysis of building constructions. Wind speed corresponding to the station has been collected. Further the Secondary data’s should be collected or based on experts opinion, and the process could be handled with help of AERMOD, which can be used to determine the direction and dispersion of particulate emissions through certain activities. Then finally recommendations could be given.

References

[1] Jhumoor Biswas, Era Upadhyay, Mugdha Nayak, Anil Kumar Yadav, An Analysis of Ambient Air Quality Conditions Atmospheric and Climate Sciences, 2011, vol.1, pg.214-224
[2] Gregory E. Muleski, Chatten Cowherd and John S. Kinsey, Particulate Emissions from Construction Activities, Journal of the Air & Waste Management Association, 2005, pg. 772-783

[3] H. Anandakumar and K. Umamaheswari, A bio-inspired swarm intelligence technique for social aware cognitive radio handovers, Computers & Electrical Engineering, vol. 71, pp. 925–937, Oct. 2018. doi:10.1016/j.compeleceng.2017.09.016

[4] R. Arulmurugan and H. Anandakumar, Early Detection of Lung Cancer Using Wavelet Feature Descriptor and Feed Forward Back Propagation Neural Networks Classifier, Lecture Notes in Computational Vision and Biomechanics, pp. 103–110, 2018. doi:10.1007/978-3-319-71767-8_9

[5] P. Balashanmugam, A.R. Ramanathan, V. Nehukumar, Ambient Air Quality Monitoring in Puducherry, International Journal of Engineering Research and Applications, 2012, vol. 2, pg. 300-307

Retracted