CONTROLLING THE RISK OF SITE DUST EXPOSURES IN SOUTH AFRICAN CONSTRUCTION

Rose Matete[1], Fidelis Emuze[2] and John Smallwood[3]

[1&3] *Department of Construction Management, Nelson Mandela University, Gqeberha (Port Elisabeth), South Africa*

[2] *Department of Built Environment, Central University of Technology, Free State, Bloemfontein, South Africa*

This paper aims to report on the aspects of exposure to site dust. The result shared in the paper is based on semi-structured interviews of construction operatives. The data were analysed thematically after transcription. The findings confirmed that dust is a major site hazard that should be assessed. Site processes, such as the removal of rubble, use of plants and tools, such as earth-moving machines, and materials, such as cement grout, lead to exposure to dust hazards. While the data shows that several tools could be used for assessment, there is a gap in the communication of risk exposure by employers to the workers. This marginalises any control attempts on sites. The concern is that employers do not encourage workers to avoid risky, dust-related work conditions when the collective on-site knows the health-related dangers of such exposures. Workers ' complaints of health-related risks are reported to be limited or non-existent. It is crucial to highlight the importance of worker training in recognising and mitigating dust hazards.

Keywords: construction; exposure; control; dust; Health and Safety; South Africa

INTRODUCTION

The construction industry is one of the primary contributors to dust pollution. The International Labour Organisation (ILO) 2013 reported that millions of workers are exposed to hazardous working conditions without a recourse to any protection system. An estimated three million workers in India are exposed to silica dust (Falk *et al.,* 2019). The South African Department of Employment and Labour (DEL) also identified the construction sector as one of the high-risk sectors in the country (Republic of South Africa, 2016). For example, contractors prioritise profit over workers' health and safety (H&S), resulting in inadequate control of major dust-related hazards. Most of the activities involved in the completion of a project can result in the generation of dust, which is released into the environment and affects air quality and the health of site workers. Such activities include transporting materials to and from the site, waste products, operating construction equipment, and earthwork, including excavation, transportation, and backfilling (Mohan and Xavier, 2022; Luo *et al.,* 2021; Li *et al.,* 2019). Pusapukdepop and Pengsaium (2018) identified insufficient control as one of the leading causes of exposure to dust in construction.

[2] femuze@cut.ac.za

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Construction dust is classified as particulate matter (PM10) or particles less than 10 microns that cannot be seen by the eye directly and can penetrate deep into the lungs and cause various health problems, including respiratory diseases and even cancer (Lorensia, Suryadinata and Savittri 2022). Emphasising the economic benefits of investing in occupational health and safety can appeal to policymakers and industry stakeholders.

Park *et al.,* (2022) suggested that rapid economic growth and industrialisation have created a new social problem and threat to human health in the form of particulate matter (PM). Quantifying PM exposure from construction activities is essential in addressing occupational health hazards in the construction industry (Guo *et al.,* 2022). Dust control measures range from simple work practices and respirators to modern technologies (Anlimah *et al.,* 2023). Cecala *et al.,* (2012) argued that if control technologies are inadequate, hazardous respirable dust levels can be released into the work environment, potentially affecting workers. If the work environment is dusty, dust will inevitably be inhaled. For example, cement dust causes lung function impairment, chronic obstructive lung disease, restrictive lung disease, pneumoconiosis and carcinoma of the lungs, stomach and colon (Republic of South Africa 2016). Adverse effects of dust at the workplace can lead to economic losses for companies in the form of legal fines, compensation for ill health, lost output, and reduced productivity (Anlimah *et al.,* 2023). Excessive or long-term exposure to respirable dust can result in a respiratory disease called pneumoconiosis, which is irreversible (Li *et al.,* 2019). Xing, Ye, Zuo and Jiang (2018) suggested that finding an effective way to control construction dust emission (CDE) is subject to obstacles. This paper reports dust exposures on sites in South African construction. The study was partly motivated by a study by Khoza, Grové and Schutte (2012), in which it was found that inadequate dust control and monitoring are prevalent in non-mining industries in South Africa.

METHOD

A qualitative method was used to produce the results shared in the next section of the paper. In line with the South African Protection of Personal Information (POPI) Act, all participants were assured of the confidentiality and anonymity of the information to be shared. Open-ended questions were used to explore the issue with professionals in frontline construction operations. A purposive sampling technique was used to select the four Construction Industry Development Board (CIDB) contractors, and the 28 participants interviewed were actively involved and well-informed about the topic. The researcher initially approached the Department of Employment and Labour (DEL) in Limpopo province for a list of projects for which contractors filed for project notification and application for construction work permits. Secondly, the Independent Development Trust (IDT) and the South African National Roads Agency (SANRAL) were also approached to assist in identifying their active construction sites in Limpopo. Thirdly, some contractors known to meet the study's criteria by the researcher were also approached to assist with a list of their active construction sites in the Limpopo province. The principal investigator engaged the interviewees from March to July 2023, and the data were collected from July to September 2023. An interview guide helped with the engagement, and examples of the interview questions included: How would you rate your familiarity with hazards linked to dust in construction work? Are stakeholders supposed to assess risks from hazards linked to dust in construction? Do employers have to conduct air quality monitoring on construction sites? Are stakeholders supposed to assess risks from hazards linked to dust in construction? Do employers have to conduct air quality monitoring on construction sites? How would you rate your familiarity with controlling hazards linked to dust in construction? Please indicate how hazards linked to dust in construction can be controlled through elimination, substitution, isolation, redesign, ventilation, lockout, and automation.

The spoken responses to the open-ended questions were automatically recorded and transcribed for thematic analysis (patterns in data) to enable interpretation. The descriptive analysis of the responses is presented in the next section of the paper. The interviewees' profiles show that 28 frontline workers participated in the study, with various roles shown in Table 1. The participants had lived experience of the subject matter since they had worked on sites for more than seven years.

Table 1: Profession of respondents

Profession	Frequency (No.)	Percentage (%)
Civil engineering	10	36
Quantity Surveying	3	11
Health and safety management	4	14
Project management	4	14
Environmental management	2	7
Structural engineering	1	3.6
Electrical engineering	1	3.6
Surveying	1	3.6
Town planning	1	3.6
Architecture	1	3.6
Total	28	100.0

FINDINGS

The responses to the questions asked in the semi-structured interviews are presented in this section.

Sources of Dust Hazards

Based on your experience, please indicate if construction processes result in exposure to hazards linked to dust.

Interviewees were asked to indicate if construction processes result in exposure to dust hazards. Almost all the interviewees (27) indicated that construction processes result in exposure to dust hazards. The interviewees indicated that the dust-generating processes illustrated in Table 2 were done through mechanical and non-mechanical work in site operations. Based on the processes in Table 2, the interviewees were asked to mention which construction plant, tools, equipment, and machines resulted in exposure to dust-related hazards. Notably, the interviewees mentioned drills, grinders, graders, boring machines, vehicles, bulldozers, excavators, tipper trucks, TLB, concrete mixing trucks, jackhammers, benches, road recyclers, concrete breakers, dynamite, earthmoving plant, angle grinders, trucks, tractors; chasing hammers; LDVs; water trucks; front-end loaders; wheel loaders; batch plant; polishing machines; sanders; conveyor belts; earthmoving machinery; binder distributors; shovels; compactors; construction vehicles; construction plant; loaders; milling machines; reclaimers; broce brooms; concrete cutters; vacuum cleaners; crushers; mechanical brooms; breakers; diesel bowsers; trenchers and cut-off saws.

Based on your knowledge, please indicate if using construction materials results in exposure to hazards linked to dust.

Most interviewees (23) believed that construction materials result in exposure to dust hazards. However, three did not believe that materials result in exposure to dust hazards, one believed that not many materials result in exposure to dust hazards, and one believed that some materials result in exposure to dust hazards.

Table 2: Respondents generating processes

Dust generating processes	
Mechanical	
Blasting (3)	Removal of rubble
Access and haul routes	Road reserves
Batch plant	Rural building construction
Blasting	Transporting excavated soil
Breaking concrete (4)	Trenching
Building of layers (3)	Finishing of borrow areas
Cleaning layers with a broom	Cutting stones
Clearing and grubbing (6)	Demolition of asbestos-bearing structure
Clearing of vegetation - grader	General cleaning of the construction site
Earthworks (5)	Transportation of material
Concrete mixing (2)	Sweeping with mechanical brooms
Crushing material (2)	Crushing
Cutting concrete (2)	Finishing of road reserve
Demolition (3)	Grinding (3)
Developing temporary roads (2)	Driving on gravel access roads with high clay content
Digging of Excavations (6)	Dust generated during the construction phase of the projects
Driving vehicles (2)	Load and haul (2)
Operating plant, machinery, work equipment	Movement of heavy vehicles over exposed soils
Operating cut-off saws	Movement of public transport
Operating drills	
Operating grinder	
Operating jackhammers	
Non-mechanical	
Building works (4)	Remedial work
Clearing of vegetation - manual	Removal of rubble
Concrete works	Trenching
Cutting bricks	Stabilisation with lime and cement (3)
Cutting plastered walls	Using brooms
Preparing plaster sand	General cleaning of the construction site
Mixing	
Bagging out cement	Handling of cement (2)
Batch plant	Dust generated during the construction phase of the project
Manual mixing of mortar with cement	

Based on the response to the above question, please mention which construction materials result in exposure to hazards linked to dust.

As shown in Table 3, interviewees mentioned the type of materials that result in exposure to dust hazards as follows: cement was mentioned (17) times; building sand was mentioned (7) times; concrete (6) times; and soil material (5); bricks were mentioned (4) times; lime (3) times; wood and gravel twice (2); clay, gypsum, grout, topsoil, SE-1 binder, dust mask, G1-G7, nylon and mortar were mentioned once(1).

Risks of Dust Exposure

Based on your response to the above questions, what assessment tools do employers use to assess risks of hazards linked to dust?

Interviewees mentioned risk assessment dust meters (12 of them), eye control tests, questionnaires (3 interviewees), breathers, DSTIs, method statements, health and safety assessments, Time-Weighted Average (TWA), dust monitors, visual inspections, dust suppression by water cart, site audits (3 interviewees), dust monitoring buckets, annual dust sampling, supervisor and employee discussions (2 interviewees), daily toolbox talks, site meetings, environmental audits, and health and safety plans.

Table 3: Type of materials that 4result in exposure to dust hazards

Type of construction materials	Number of mentions
Cement	17
Building sand	7
Concrete	6
Soil material	5
Bricks	4
Lime	3
Gravel, wood	2
Clay, crusher, dry GI-G7 material, tylon, mortar	1
Gypsum, Grout, Topsoil, SE-1 binder	1

Based on your experience, please indicate if employers communicate risks linked to dust in construction.

As shown in Figure 1, most interviewees (22) indicated that employers communicate risks linked to dust in construction. Other responses are presented verbatim as follows:

> 'Once again, I am not too sure what, and what is usually done during an H&S inspection, but I am sure that as part of that, it should be communicated. However, once again, I am not aware of the communication specifically that relates to dust in construction' (Interviewee 1).

> 'Employers appoint an H&S Management team to assess the hazards linked to dust exposure. The team drafts various site-specific documents and procedures that will be implemented on-site. These documents and procedures will be communicated with each employee conducting work activities on the construction site' (Interviewee 28).

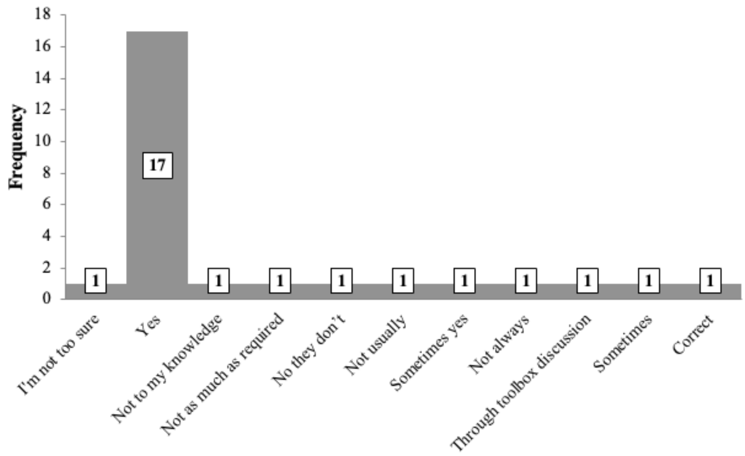

Figure 1: Communication of risks by employers

Based on your experience, please indicate whether employers encourage workers to resist risky work conditions.

Most interviewees (20) confirmed that employers encourage workers to resist risky work conditions. The least number of interviewees (4) did not think employers encourage workers to resist risky work conditions. The responses from other interviewees are presented verbatim as follows:

> 'It is now a standard practice to inform employees that they are not obliged to work under unsafe conditions' (Interviewee 6).

> 'Regular toolbox talks are conducted on-site to ensure that employees are safe, and the proper protective gear is provided' (Interviewee 10).

Based on your knowledge, please indicate if you are aware of any health risks related to hazards linked to dust in construction.
Interviewees were aware of health risks related to dust hazards. Responses of other interviewees are presented verbatim below:

> 'Hazardous dust most of the time gets into contact with skin which creates skin irritation and, if a person breathes that particular dust, sometimes it creates lung cancer and, in most cases, inhaled contaminated dust also creates lung cancer' (Interviewee 12).

If yes to the above question, please discuss how such health risks affect workers.
Interviewees mentioned it would affect the lungs, breathing capacity, and overall health. Workers are susceptible to potential long-term infections of the lungs. These infections could lead to lung and throat cancer and chest and lung infections because of continuous exposure. A person could develop lung function problems. Lung infections could result in bronchitis, influenza, and/or TB, leading to respiratory problems, absenteeism, low morale, and reduced productivity. These infections might also cause cancer and or death to the workers. These risks affect eyesight and lungs, thereby causing long-related illnesses. A sample verbatim response is below:

> 'The most common health risk of excessive dust exposure is respiratory infections. Moreover, respiratory infections affect an individual's breathing patterns and make breathing typically difficult (Interviewee 28).

Based on your experience, please indicate if you are aware of any complaints of health risks related to dust-related hazards.
Most interviewees (17) were not aware of any complaints of health risks related to dust hazards. Notably, seven (7) interviewees indicated that they were aware of health risks.

Based on your experience, please mention the type of controls used to control hazards linked to dust in construction.
Interviewee 2 mentioned spraying water frequently to minimise the dust. Interviewee 3 mentioned the issuing and wearing of PPE, including dust masks. Interviewee 5 suggested visual evaluations. Interviewee 6 thought of the use of extractor fans in buildings. Interviewee 7 suggested sealing temporary by-passes. Interviewee 10 mentioned the provision of dust control chemicals on haul routes. Interviewee 15 mentioned administrative controls such as training. Interviewee 17 said they must conduct risk assessments for every activity on-site to minimise the exposure. Interviewee 23 said that, because of low visibility, the Traffic Safety Officer (TSO) would become involved if required. Interviewee 26 suggested dust suppression via emulsion.

The responses from other interviewees are presented verbatim below:

> The first one is engineering control, which is redesigning or combating the source of the dust. However, if that is not possible, we use the dust suppression method, a water tank suppressing the dust throughout the project and giving workers PPE where necessary, such as the respirator or dust mask if the dust is hazardous' (Interviewee 12).

> 'Water trucks frequently spraying water on dusty work areas. Dust exposure monitoring with dust buckets by frequently collecting the dust buckets and sending the dust buckets to the scientific lab for the dust results. Provide employees with adequate personal protective equipment (PPE)' (Interviewee 27).

The study revealed that people are familiar with dust-related hazards in construction work. Almost all the interviewees (96%) confirm that construction processes result in exposure to hazards linked to dust; processes that result in exposure to dust hazards the most are clearing and grubbing, digging of excavations, earthworks, breaking concrete, building works and demolition, blasting, grinding, stabilisation with lime and cement, layout works and concrete works, all of which concur with the findings of Kumi *et al.,* (2022) which indicated that earthwork, masonry work, structural work, steel and metal work, demolition work, pavement work, reinforced concrete work and temporary work have the highest dust concentrations.

The professionals overwhelmingly (100%) confirmed that construction plants, tools, equipment and machines lead to exposure to hazards linked to dust. They suggested that those that lead to dust hazards the most are drills, grinders, graders, vehicles, excavators, tipper trucks, TLBs, concrete mixing trucks, jackhammers, and compactors. Yan *et al.,* (2019) indicated that dust emissions in construction sites are influenced by multiple factors, which can range from vehicles driving out on construction sites, which carry a large amount of dust and sediment, to nearby roads causing secondary dust to rise under external force, and concrete mixing, drilling, and cutting activities. The interviewees agreed that construction materials result in exposure to hazards linked to dust, and they mentioned that cement, building sand, concrete, bricks, soil material and gravel result in dust hazards the most.

The interviewees suggested using assessment tools such as risk assessment, questionnaires, method statements, site audits, dust meters, eye control tests, breathers, time-weighted average (TWA), dust monitors, dust monitoring buckets and environmental audits. Interviewees also indicated that employers do communicate risks linked to dust. They encourage workers to resist risky work conditions. They suggested that this is done through induction training, regular toolbox talks, the daily-weekly DSTIs and the provision of proper PPE and risk assessment. Interviewees are aware of health risks related to hazards linked to dust in construction. They know that dust-related health risks can affect the lungs and breathing capacity, resulting in respiratory and cardiovascular health problems, skin irritation, eye problems, lung cancer, asthma and sinus.

Interviewees suggested that engagement with workers should eliminate or minimise hazards linked to dust in construction by making them aware of the consequences of dust hazards, and workers must comply with the requirements set out to avoid exposure to dust. Interviewees also confirmed that regulations require the use of PPE and PPC issued to them and compliance with instructions to wear masks. Employees must also participate in all training and awareness campaigns and notify the stakeholders if any of the implemented dust control measures are ineffective. They must also assist in conducting adequate monitoring of construction sites. Luo *et al.,* (2021) suggest that informing workers about the severe health hazard of long-term exposure to high levels of dust can change the attitude and behaviours of construction personnel with the help of communication.

The findings of study revealed that contractors employ various dust control measures such as the following: frequent water spraying; wearing PPE (e.g., dust masks, overalls, safety boots, safety glasses and safety gloves); visual evaluations; extractor fans in buildings; dust control chemicals on haul routes; regular cleaning of workstations; training (e.g., toolbox talks); risk assessments; involvement of TSOs; dust suppression via emulsion; provision of clean water with soap for washing hands; and dust monitoring with dust buckets. Interviewees confirmed that employers provide the capacity to control hazards linked to dust in construction and that they improve workers' knowledge and attitude in terms of control of hazards linked to dust. Interviewees also suggested that supervisors must be empowered to control dust-related hazards. They suggested that employers must implement baseline medical screening because medical screenings identify potential lung concerns sooner rather than later. They help detect illnesses and determine whether employees were affected before or after joining the sites.

The study's findings revealed that appropriate PPE prevents exposure to hazards linked to dust because dust masks prevent excess inhalation of dust. Hence, dust particles are prevented from entering the lungs, preventing afflictions such as asthma. Furthermore, the study revealed that safety goggles prevent eye dust exposure. Interviewees believed that full overalls prevent the body from encountering dust hazards. Safety gloves prevent the hands from encountering dust particles. The study also revealed that elimination, substitution, isolation, re-design, ventilation lockout and automation can control dust-related hazards in construction.

The study's findings further revealed that sustainable construction practices reduce dust emissions on construction sites, especially if followed. Interviewees mentioned recycling materials, use of automated machinery instead of humans, piling, dust barriers and windbreaks, use of dust suppression agents, closing or covering dusty activities or materials, implementing vacuum or dust collection systems, solid temporary routes such as concrete or paved access roads leading to the site camp and lay down areas. This concurred with the findings of Giunta (2023: 145), who found that engineering and administrative/management control could help to manage and reduce the issue and the degree of exposure. Giunta (2023: 145) also found that, among the engineering control measures, wetting of dusty surfaces is the most popular and effective and, if combined with a dust collection system, makes it possible to reduce the exposure of workers to dust by 90% and 70%, respectively. Giunta (2023) also noted that maintaining standard heights for stockpiling, washing the wheels of vehicles, and wetting surfaces during loading and downloading materials are straightforward methods to control the dust generated at sites. Giunta (2023) found that chemical agents, electrical sweepers, dust screens, and LEV are some technologies that help construction companies manage dust pollution.

CONCLUSIONS

This paper aimed to report on exposure to dust on-site in construction operations. The aim was achieved using a qualitative approach with textual data collected from frontline operatives on four construction project sites. The data showed that dust is a major health issue in construction, and the people (construction workers and professionals) know it. Most interviewees indicated that construction processes result in exposure to dust hazards. Normal construction processes, such as clearing and grubbing, digging of excavations, earthworks, breaking concrete, building works, demolition, blasting, grinding, and stabilisation with lime and cement, result in exposure to dust hazards.

Apart from construction processes, plants, tools, equipment, and machines also result in exposure to dust hazards. Even though the frontline operatives know that construction processes and use of construction plants, tools, equipment, and machines result in exposure to dust hazards, they appear to have limited knowledge of health risks related to dust hazards in construction. Their lack of awareness of health risks is a concern because they are frontline workers. The study found that stakeholders in South African construction sites are dedicated to controlling dust-related hazards, but the current interventions are ineffective.

Employers in construction are not supposed to conduct air quality monitoring. Frontline operatives are familiar with the control of dust hazards, employers provide the capacity to control dust hazards, and supervisors are empowered to control hazards. Employers have also been found to improve workers' knowledge and attitudes regarding controlling dust hazards. The study further concludes that the industry needs to implement engineering, administrative, sustainable practices, innovation, and technology to control dust effectively.

The limitation of most qualitative studies applies to this paper. The results can apply to similar contexts in developing countries, but their statistical generalisation is impossible. The results thus serve as building blocks for propositions that would drive future studies that might include the on-site containment of dust hazards.

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REFERENCES

Cecala, A B, O'Brien, A D, Schall, J, Colinet, J F, Fox, W R, Franta, R J, Joy, J, Reed, W R, Reeser, P W, Rounds, J R and Schultz, M J (2012) *Dust Control Handbook for Industrial Minerals Mining and Processing*, Available from https://www.cdc.gov/niosh/mining/UserFiles/works/pdfs/2012-112.pdf [Accessed: 16 June 2024].

Falk, L, Bozek, P, Ceolin, L, Sobers, M, Cole, D.C, Levitsky, M, Malik, M and Patel, J 2019 Reducing agate dust exposure in Khambhat, India: Protective practices, barriers and opportunities, *Journal of Occupational Health*, **61**(6), 442-452.

Giunta, M (2022) Sustainable practices in road construction: Estimation and mitigation of impact on air quality, *In*: *Proceedings of AIIT 3rd International Conference on Transport and Infrastructure and Systems (TIS ROMA 2022*), 15th -16th September, Rome, Italy, 139-146.

Guo, X, Wang, Y, Mei, S, Shi, C, Liu, Y, Pan, L, Li, K, Zhang, B, Wang, J, Zhong, Z and Dong, M (2022) Monitoring and modelling of PM2.5 concentration at subway station construction based on IoT and LSTM algorithm optimisation, *Journal of Cleaner Production*, **360**(132179), 1-17.

International Labour Organisation (ILO) (2013) *The Prevention of Occupational Diseases*, Available from: https://www.ilo.org/wcmsp5/groups/public/---ed_protect/---protrav/---safework/documents/publication/wcms_208226.pdf [Accessed: 22 May 2019].

Khoza, N N, Grové, T and Schutte, P C (2012) *Worker Exposure to Silica Dust in South African Non-Mining Industries in Gauteng: An Exploratory Study*, Available from: http://researchspace.csir.co.za/dspace/bitstream/10204/5947/1/Khoza2012.pdf [Accessed: 16 June 2024].

Kumi, L, Jeong, J, Jeong, J and Lee, J (2022) Empirical analysis of dust health impacts on construction workers considering work types, *Buildings*, **12**, 1137.

Li, C Z, Zhao, Y and Xu, X (2019) Investigation of dust exposure and control practices in the construction industry: Implications for cleaner production, *Journal of Cleaner Production*, **227**, 810-824.

Lorensia, Suryadinata and Savittri (2022) Available from: https://www.researchgate.net/publication/364743891_COPD_Symptoms_and_Risk_Factors_of_Respiratory_Disorders_in_Builders [Accessed: 16 June 2024].

Luo, Q, Huang, L, Xue, X, Chen, Z, Zhou, F, Wei, L and Hua, J (2021) Occupational health risk assessment based on dust exposure during earthwork construction, *Journal of Building Engineering*, **44**(103186), 1-15.

Mohan, G and Xavier, A S (2022) Impact of dust on health of on-site construction workers - A case study, *Journal of Sustainability, Agriculture, Food and Environmental Research*, **10**(1), 1-8.

Park, J, Park, Y, Yoo, J L, Yue, G and Yu, J (2022) Can the perceived risk of particulate matter change people's desires and behavioural intentions? *Journal of Frontiers on Public Health*, **10**(1035174), 1-14.

Pusapukdapop, J and Pengsa-ium, V (2018) *Measures to Reduce the Impact of Dust from Construction in Bangkok*, Available from: https://ssrn.com/abstract=3182991 [Accessed: 16 June 2024].

Republic of South Africa Department of Labour (DoEL) (2016) *Occupational Hygiene in Construction Work*, Available from: https://www.labour.gov.za/DocumentCenter/Publications/Occupational%20Health%20and%20Safety/Occupational%20hygiene%20in%20construction%20work.pdf [Accessed: 16 June 2024].

Xing, J, Ye, K, Zuo, J and Jiang, W (2018) Control dust pollution on construction sites: What Governments do in China? *Sustainability*, **10**, 2945.

Yan, H, Ding, G, Li, H, Wang, Y, Zhang, L, Shen, Q and Feng, K (2019) Field evaluation of the dust impacts from construction sites on surrounding areas: A city case study in China, *Sustainability*, **11**(7), 1906.