

Major Excavation Hazard in Cape Coast Metropolis

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Abstract

The constant changing working environment within the construction industry has contributed to its health and safety nightmare. Excavations and trenches collapse have also contributed to major injuries on employees and leading to their unfortunate death. Experts' views were used, during a Delphi survey to assess hazards during excavation work. The experts were made up of a health and safety personnel, a quantity surveyor, a structural engineer, a construction manager, a project manager, a building technologist and an architect in Cape Coast Metropolis. Findings from the study show that the extent of excavation depth and nature of the strata (soil variations creating the potential for the sides to collapse) were ranked first and second with a mean of 9.25 and 9.00. These two variables were considered by experts to have a very high impact (VHI: 9-10) on the influence of excavation hazard and impact of contractors' perception. Further findings show that very few employees observed the construction regulations, while almost all the employees obeyed the OHS requirements. Attention should be given to proper planning and immediate action towards excavation hazards.

Keyword: Accident; cave-ins; collapse; injury; risk

1. Introduction

Excavation and trenching are among the most hazardous construction operations in the construction sector (Occupational Safety and Health Administration, 2005). The construction sector in Ghana is dynamic and a contributor to the economy of the country. The sector involves several stakeholders and has wide range of linkages with other areas of activities which may contribute to accident on sites (Construct Ghana, 2018). Construction workers engage in many activities that may expose them to serious hazards, such as falling from rooftops, unguarded machinery, being struck by heavy construction equipment, electrocutions, silica dust, and asbestos (United States Department of Labour, n.d.). Accidents happen on sites more often because they are unfortunate incidents that occur unexpectedly and unintentionally, typically resulting in damage or injury (Merriam-Webster, 2018). *Accident* "can be read by some as a term exonerating the person responsible." Serious injuries and fatalities result from collapsing trenches and

excavations occur annually. Collapses are more of accidents waiting to happen (APROPLAN, n.d.). This paper assessed excavation hazards on construction sites in Cape Coast Metropolis.

2. Literature

2.1 The construction sector

Construction sites are a health and safety nightmare, due to the constant changing environment. This situation makes it a dangerous zone for most of the conceivable hazard. The rate of accident fatality in the construction industry stands at more than double that of the all sector average (Alcumus Group Ltd., 2018). Construction sites can get quite hectic with the volume of constant moving vehicles, overhead lifting equipment shifting heavy loads, supply vehicles, maneuvering dumper trucks, around a usually uneven terrain (Alcumus Group Ltd., 2018). The risk of an unintended collapse is generally more associated with demolition works or when a partially completed building or scaffolding collapses, but still accounts for a percentage of fatalities each year (Alcumus Group Ltd., 2018). Excavation accidents has been identified as one of the leading safety hazards on site (OSHA, 2005).

Most hazardous construction operation occur in cave-ins and they are the greatest risk. Most accidents in excavation occur in 5-15 ft deep as shown in Fig. 1.

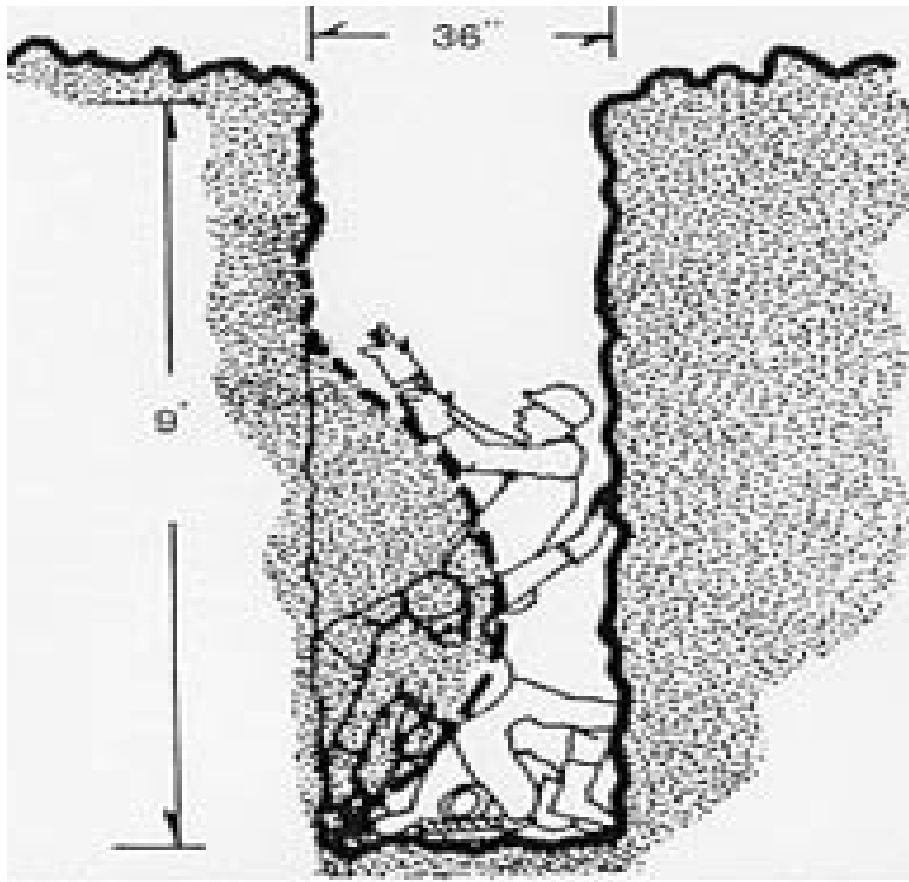


Figure 1:

Any narrow underground excavation that is deeper than it is wide, and not wider than 15 feet (4.5 meters) as shown in Fig. 1 is considered to be hazardous (Occupational Safety and Health Administration (OSHA) (n.d.). Construction sites trench excavation usually lead to injuries and deaths of workers. Majority of the accidents in excavation occur as a result of cave-ins occur on small jobs, such as water, gas, electrical and sewer line connections. When it occurs, workers are critically injured simply because both the employers and the employees, as well as the supervisors have

failed to follow the laid down requirements in the Occupational Health and Safety Act (OHSA) and Regulations for Construction Projects (Safe at Work (2015). The risk in trench excavation can be prevented by ensuring that employers provide different types of protection for their employees such as sloping, shielding, and shoring the excavation. Moreover, the need to involve the services of a competent person who should be responsible for inspection of the excavation works (Occupational Safety and Health Administration, 2005),

3. Methodology

This section provides information on the various methods employed in the data collection. Factors that have influence on excavation hazard and impact of contractors' perception on excavation hazard were obtained through Delphi survey. Experts were made up of construction professionals in Cape Coast Metropolis. Thirteen experts were consulted at the initial stage of the survey. Four experts were dropped during the second stage of the survey, due to their inability to meet the given deadline for submission. The remaining nine experts continued with the survey till the end. The professionals were made up of a health and safety personnel, a quantity surveyor, a structural engineer, a construction manager, a project manager, a building technologist and an architect. The academics were made up of a structural engineer and an architect. During the survey, experts were rate the factors that have influence on excavation hazard and impact of contractors' perception on excavation hazard. Microsoft Excel spread sheet was used in the data analysis. The nine experts used for the study and was considered by Mustapha, Aigbavboa and Thwala (2018) Aigbavboa (2013) who have employed the technique in recent years, to be adequate.

4. Findings and Discussions

This section discusses the results from the Delphi survey. Table 1 shows ranking of the variables based on mean for contractors' perception on excavation hazard. A Delphi survey was conducted to determine which of the thirteen (13) variables of Contractors' Perception on Excavation Hazard features have influence on accident. Experts were asked to rate the impact of other factors in predicting SME contractors' growth. Data obtained were analyzed using Microsoft Excel spread sheet. Only three (3) variables out of the thirteen (13) identified variables were considered by the experts to have reached consensus with a median score of Nine (9) set to achieve consensus (Table 1). Another three (3) of the variables reached consensus under the median score of eight (8). Presence of load close to the edge of the zoned of influence, exposure to wet weather and the presence of existing underground services within the area of the excavation also reached consensus with a high impact (HI: 7-8) to determine the Perception Contractors' on Excavation Hazard. The remaining four (4) other variables had medium impact (MI: 5-6).

Table 1: Factors that have influence on excavation hazard

Variables	Median	Mean	Ranking
The extent of excavation depth	9	9.26	1
Nature of the strata (soil variations creating the potential for the sides to collapse)	9	9	2
Presence of water, exposure to wet weather	8	8.71	3
Any load close to the edge of the zoned of influence	9	8.5	4
The presence of chemical gases within the excavation area	8	7.86	5
Presence of load close to the edge of the zoned of influence	7	7.57	6
The result of vibration from other activity which may increase the potential to collapse	8	7.43	7
Exposure to wet weather	7	6.8	8
The presence of existing underground services within the area of the excavation	7	6.57	9
Proximity of adjacent excavations to the current one	6	6.43	10
Fractures or faults close to the excavation area	6	6.17	11

Presence of adjoining buildings	6	6.14	12
The time under which the excavation works will be carried out	6	6	13

Table 2 shows that three (3) variables (the extent of excavation depth, nature of the strata (soil variations creating the potential for the sides to collapse) and any load close to the edge of the zoned of influence) reached consensus with a very high impact (VHI: 9-10). Six (6) other variables reached consensus with high impact (HI: 7-8). The remaining four (4) variables also reached consensus with a median impact (MI: 5-6).

Table 2: Impact of Contractors' Perception on Excavation Hazard

Variables	Median	Impact
The extent of excavation depth	9	VHI
Nature of the strata (soil variations creating the potential for the sides to collapse)	9	VHI
presence of water, exposure to wet weather	8	HI
Any load close to the edge of the zoned of influence	9	VHI
The presence of chemical gases within the excavation area	8	HI
Presence of load close to the edge of the zoned of influence	7	HI
The result of vibration from other activity which may increase the potential to collapse	8	HI
Exposure to wet weather	7	MI
The presence of existing underground services within the area of the excavation	7	MI
Proximity of adjacent excavations to the current one	6	MI
Fractures or faults close to the excavation area	6	MI
Presence of adjoining buildings	6	MI
The time under which the excavation works will be carried out	6	MI

VHI – Very High Impact; HI - High Impact; MI - Medium Impact

Table 3 shows that the most observed before excavation works were to remove debris and excavated soil near excavation site and notification requirements. These two variable were ranked higher than any other variable. The least ranked variable are workers shall not perform work in trench unless another worker is working above ground and plan for removing water in excavation.

Table 3: Construction regulations before excavation works

Construction Regulations	Yes	No	Ranking
Remove debris and excavated soil near excavation site	9	0	1
Notification requirements	9	0	1
Arrange to protect workers from falling into excavation	7	2	3
Know soil types and what sloping, shoring or pre-fabricated, hydraulic or engineer systems required	7	2	3
	7	2	3
Requirements for when support system must be engineered	7	2	3

Identify and locate overhead power lines and underground services	6	3	7
Prepare emergency plan	6	3	7
Obtain utility locations before digging	6	3	7
Workers shall not perform work in trench unless another worker is working above ground	5	4	10
Plan for removing water in excavation	5	4	10

Table 4 shows that almost all the variables under OSHA requirements were obeyed by employees during excavation works and were ranked first and second. The least on list of variables is provide training to workers.

Table 4: OSHA requirements before excavation works

OSHA Requirements	Yes	No	Ranking
Know in advance what excavation equipment and tools are needed	7	2	1
Consider possibility of environmental hazards (rain) in excavation	6	3	2
Determine how workers will enter and exit excavation	6	3	2
Be aware of nearby vehicles and mobile equipment causing soil to vibrate	6	3	4
Provide training to workers	5	4	5

5. Conclusion and Recommendation

The study assessed excavation hazard and presents possible preventive measures based on contractors' perception. Two variables were ranked to have more influence on excavation hazard based on the mean, but three variables were found to have very high impact (VHI). Two of such variables (the extent of excavation depth and nature of the strata happened to have both influence and impact on excavation hazard. This indicates how dangerous these variables pose to employees during excavation. Emphasis should be placed on these variables and any other variable found to pose serious danger to employees. It was observed that few of the construction regulations were observed by employees. While most of the OSHA requirements were obeyed by employees. All hazards identified should be carefully analyzed and appropriate measures put in place to minimize or prevent serious accident on site. Planning for excavation hazard should be well executed and prompt action taken when due. Further studies should be conducted using a different method to ascertain the extent of accident and cost incurred in relation to excavation hazard on employees.

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