

# Designer's contribution to construction health and safety (H&S) – A case study of a public works project

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## Abstract

**Purpose** –This paper presents findings from a study conducted on a public works' construction project in Botswana to establish the contribution of designers (consultants) to construction health and safety (H&S).

**Methodology** – A case study of project XYZ funded and managed by a large Government department responsible for all educational development projects was conducted. Interviews were also conducted with the project stakeholders specifically consultants and the contractor. A major H&S hazard of deep excavations in collapsible soils was identified and was used to evaluate the contribution of designers to the management of H&S.

**Findings** – Findings from the study suggest that the involvement of designers in the management of H&S was minimal and that they lacked the capacity and the will to address H&S.

**Originality / value** – the construction industry is dogged with many problems concerning H&S. Accidents still occur in the industry and there is little progress in improving H&S of construction workers. This paper therefore provides an insight as to why progress may be slow compared to other industries. It is hoped that understanding this would contribute towards H&S performance improvement.

**Keywords:** Designers, health and safety, performance improvement

## **1.1 INTRODUCTION**

Many researchers on H&S agree that H&S is not an issue that can simply be left to contractors alone. Designers (project consultants) must be involved (Behm2005:1, Hinze 1999: 400 and Suraji et al 2006: 58). According to Hinze (1999: 400), it is naive to suggest that designers have no role in construction H&S. Hinze (1999: 400) maintains that decisions made by a designer have a direct impact on the H&S of construction workers. Mackenzie (1999: 420) also cited design decisions as being one of the causes of accidents on construction sites. A lack of full participation by designers in construction H&S has a negative impact on H&S.

When H&S is considered in the design of structures or when designs are appraised in terms of H&S, action plans are developed to ensure that risks are engineered out of the system before they are able to cause injury, disease, damage, or even loss of life on site. In a pro-active manner, Behm (2005:2) defines design for construction H&S as being the consideration of site safety in the design of a project. Specifically this includes: modifications to the permanent features of the construction project in such a way that construction site safety is considered; attention during preparation of plans and specifications for construction in such a way that construction site safety is considered; the utilisation of specific design for construction safety suggestions; and the communication of risks regarding the design in relation to the site and the work to be performed. Consideration of H&S in design of facilities is a very significant step in working towards H&S performance improvement.

Extensive designer participation is essential for successful implementation of H&S as design professionals influence construction H&S outcomes both directly and indirectly (Behm 2005: 4). Designing for H&S is an all-inclusive activity. It applies to facilities, selection of materials, operations layout, work methods and procedures, work scheduling, maintenance requirements, and PPE needed (Manuel 2003: 453). Designer contribution as noted earlier would therefore make a difference and enhance H&S performance

However, some contend that designers cannot be relied on entirely for H&S performance improvement. Gambetese & Hinze (1999: 643) argue that many designers currently lack skills in designing to avoid or reduce H&S risk. Behm (2005: 2) also maintains that most designers continue to reject the responsibility of designing for H&S as part of their standard practice and there are no motivating forces to entice design professionals to adopt the concept. If that is the situation, then there is therefore cause for concern and this study is an effort to try and establish whether it is actually true that designers lack the skill and are not necessarily motivated to be involved in H&S.

The motivation of the study was that designers are very important to H&S performance improvement in the construction industry and therefore should be actively involved.

## **2.0 RESEARCH**

### **2.1 Methodology**

The study was qualitative and involved a case study of a public works project XYZ. The selected project as mentioned was a public works project, funded by a Government department responsible for most of the Government education infrastructures. For the year 2007/08 financial year, this department was allocated more than 8% of the entire national development budget for the construction of new educational facilities in the country. The department oversees all projects with the help of private consultants. In short, the department acts as the client for all government educational facilities.

It was considered a study of project XYZ where this department was the client, would provide insight on H&S management plans in many other projects managed by the same client with particular emphasis on designer contributions.

The aim of the study was to evaluate designers' contribution to H&S management on the project. The method of measurement needed to be developed to understand designers' contribution by evaluating specific actions, reactions and interventions by designers on real site H&S issues including prior planning on particular H&S issues. The identified major site hazard of *deep excavations in highly collapsible soil* was used to establish the extent to which designers considered and contributed to H&S performance.

The method entailed conducting interviews with the project manager, designers, client representatives and the contractor representative. Observations of the site and study of contract documents was also conducted in order to have a full understanding of project information especially relating to the identified site hazard.

To establish the extent of the contribution of designers to H&S performance with particular reference to the identified hazard the following were considered, namely:

- Whether the client, designer (Civil engineer), project Manager (Architect), quantity surveyor and the contractor had known at pretender stage that sewerage excavations were very deep and would pose a risk to H&S;
- Whether H&S in general was highlighted by the client and the designer during the design brief;
- Whether any project documentation highlighted the risk that deep excavations were going to pose once works had commenced, and the
- Reaction of the client, project manager, quantity surveyor and contractors after the hazard had become known or apparent to them.

The limitation of the study is that the results can not necessarily be generalised to the entire construction industry as other designers working with other clients may be contributing significantly to H&S performance. Results from this study do however inform about what may be happening in the industry and probably explain the current H&S climate in the construction industry in Botswana.

## **2.2 Findings**

### **2.2.1 Description of the hazard**

Project XYZ, involved among other construction works, the construction of a net work of sewer lines for a new senior secondary school, in the Kgalagadi district, Botswana. The minimum depth of the excavations was one meter and the maximum depth was about five meters for a stretch in excess of one kilometre.

The soils in the area had been established as sandy and highly collapsible. The soil stratum was only determined to be stable at about one to two meters from the trench final levels.

The excavation width was supposed to be 700mm. The chosen way to excavate these trenches was by using mechanical excavators. Upon completion of excavations with an excavator, trimming of sides, cleaning and levelling of trenches were to be done by hand. Workers had to be taken down into the trenches of depth up to four meters and 700mm wide.

After trimming, cleaning and levelling of the trenches, workers had to compact the base to provide a firm base upon which sewer pipes could be laid. Pre-cast concrete manholes were placed by mechanical means but directed into position by a construction worker in the trenches.

The following risks were identified after a study of the construction drawings and observations on site:

- Sides of trenches would easily collapse with the trenches being excavated as per drawings, i.e. with trench sides at 90 degrees all the way to the bottom;
- It was also reasoned that the chances that sides of trenches would collapse during compaction of the base and bury construction workers were very high. The soil was highly collapsible and vibrations from the compacting machine could easily trigger the soil collapse;
- Possibility of one of the construction workers getting trapped under collapsed soil and literally be buried alive were also very high and therefore this activity posed a major H&S risk.



Fig 1: Manholes installed in deep excavations



Fig 2: Partly excavated trenches

### 2.2.2 Consideration of H&S at design stage

In order to establish whether H&S was considered at design stage and using the identified hazard as the litmus test, the following was done, namely

- Determine from contract documents whether the hazard was highlighted on any of the contract documents;

- Establish any special instructions from the designer to the main contractor for example to provide a method statement such that they (engineer) were satisfied that the works would be carried out in a safe manner;
- Find out from the designer by way of an interview whether they had knowledge at design stage of the fact that the works posed a risk to H&S;
- Find out from the project manager, client, quantity surveyor and the main contractor whether they had been alerted to the fact that excavations would pose a risk to H&S of construction workers;
- Find out from the project manager by way of an interview whether during the design briefing by the client, H&S was included as one of the deliverables.

Concerning the first objective i.e. to determine whether any of the contract documents contained information pointing to the fact that deep excavations posed a H&S risk on the project, the study revealed that there was no information on any of the contract documents that pointed to that fact. A complete set of architectural and engineering drawings were studied including special additional specifications for the works. Further, a study of the bills of quantities and standard specifications were also studied. None of the descriptions highlighted the fact that special allowance was to be made for excavating in highly collapsible soils to a depth of up to four meters.

As for special instructions from the designer to the main contractor including the requirement of submitting method statements specifically to highlight the H&S aspect in relation to the deep excavations or in general for that matter, the study again revealed that there was nothing to that effect. The main contractors' files were studied including any submittals that were required by the designers and the project manager. It was found that there was no special attention paid to this significant hazard and therefore there was no special requirement for the contractor to submit a method statement or even to be warned of the risk that the deep excavations posed to workers' H&S.

Regarding the question of whether designers had known or realised at design stage that the deep excavations would pose a H&S risk and therefore needed special attention, the response during the interview was that they definitely knew that the depths were in excess of two meters but not necessarily that they posed a H&S risk. According to the designer, they simply worked on topographical maps produced by surveyors and that is where they based their design. The designer further indicated that it was actually the main contractor's responsibility to ensure that works proceeded in an environment that never compromised H&S. A comparison of the designer's response at this stage and the actual reaction when it became apparent that excavations posed a high risk to H&S, somehow revealed that the designer never really knew at design stage that the excavations posed a great risk to workers H&S. When the excavations were done, the designer was willing to 'help' the contractor obtain instructions from the project manager and client to address the now apparent problem.

As to whether all parties, namely the client, project manager and the quantity surveyor, had knowledge of how deep the sewerage excavations were going to be, all except the designer indicated that they were not so clear or rather did not know of the depth and type of soil to the extent that they would pose danger to construction workers. They argued that if that had been brought to their attention, somehow they could have informed and convinced the client to include for the intervention measures.

One forum that is used to discuss all the required deliverables on a proposed project is the design briefing. Clients spell out what they want to be delivered and designers accordingly advise on many other technical elements that may be required on the project. It was deliberately decided therefore that the designers be asked as to whether H&S was highlighted by either party during the design briefing and or before the project contract was awarded to the contractor. The engineer and the Architect who were the main designers on the project all responded that H&S was not really mentioned during the design briefing or at any other time before the contractor was commissioned. It was observed that generally, just like in many other projects with other clients, project briefings only centred around the project itself and not necessarily on issues such as H&S. They indicated that usually, clients do not give them a mandate to manage H&S on construction projects.

Regarding the question of whether the main contractor had realised at the time of tender that they needed to pay special attention to excavations in order to avoid the H&S risk posed by the deep excavations in highly collapsible soils, they responded that they had not. According to the contractor, the tender period is usually very short and therefore they have limited time in which to consider all elements for pricing least of all H&S.

### **2.2.3 Designer's contribution to H&S at contract stage**

Using the identified hazard of *deep excavations in collapsible soils*, an insight was sought on what role designers played to contribute to H&S performance when the works had actually commenced i.e. at contract stage.

Literature informs that designer's contribution to H&S performance at contract stage can be seen by the designer getting involved in at least one of the following activities:

- Prioritise H&S during project meetings;
- Conduct H&S audits;
- Pay attention to H&S during preparation of plans and follow through during construction;
- Provide specifications for construction in such a way that H&S is considered and
- Communicate anticipated H&S risks to the contractor.

The researcher had an opportunity to attend several site meetings for the project. It was noted that H&S was not really given the prominence that it deserves. It was only during the time that the deep excavations in collapsible soils came up that H&S was mentioned in some of the meetings. Similarly it was learnt from the main contractor that none of the project team had ever conducted H&S audits on the project.

Regarding the aspect of paying attention to H&S during preparation of plans and following through to ensure compliance just like on other elements such as the quality of concrete, the designer indicated that they had a full knowledge of the depth of trenches but it was not necessary to mention it on the drawings as they expected to engage a competent contractor. From the observations on site, this however was found not to be the case as the designer seemed to have been taken by surprise when the contractor embarked on the works as well as when the contractor raised concern on the safety of the works. The designer having realised the serious risk the works posed to workers' H&S, offered to 'help' the contractor have their proposal to avoid the risks be approved. The

contractor's proposal included carrying out excavations such that sides of trenches were excavated at an angle stable enough to avoid soil collapse. The other proposal was to place a weak concrete base to lay pipes on as opposed to the compaction which had a higher likelihood to cause or trigger a soil collapse. The main problem of the contractor's proposal was that it entailed extra cost to the project. Although the designer had offered to help the contractor get paid, they could not really commit or recommend to the project manager and the client that that was the best solution to address the problem. From the designer's conduct, it seemed that committing themselves to the proposal, could have placed a lot of responsibility on them.

It was also observed that the main contractor was not provided with specifications or notes highlighting risks that were associated with the particular section of works. This was not surprising as noted earlier, designers never seemed to have realised at design stage the risk that the excavations posed to workers' H&S. The fact that H&S was not considered at design stage, made it impossible obviously for documents to be produced that addressed H&S.

Further, the following was observed from the study:

- The designer's attitude when the problem surfaced revealed that they were not willing to bear any responsibility. This became evident when the designer could not recommend to the client the main contractor's proposal even though the contractor specifically requested the designer to do so. The designer however opted for leaving the problem with the contractor who in turn never committed the required resources to address the problem.
- There is generally lack of skills on the part of designers to address H&S. From the study, it was realised that designers only realised that excavations posed a high risk to H&S of construction workers the moment the works were embarked on and especially when the contractor raised concern.

### **3.0 DISCUSSION**

The above findings are important as they provide insight on one of the causes of poor H&S performance in the construction industry. Although a fatality or incident was not recorded on that site, it does not necessarily mean or indicate that the H&S conditions were right. All the leading indicators pointed to a very high likelihood of a fatal accident.

In order to have the right H&S culture and indeed a better H&S performance, literature informs that designers need to be more involved. Designers play a very important role in H&S performance given their expertise and services that they render both to the client and the contractor. From the study it was clear that designers' contribution to H&S in planning and management was insignificant. The designer (engineer) for example having noticed that the excavations were going to be very deep and that they were going to be done in highly collapsible soils, could have raised alarm if H&S was a priority or rather if they possessed the right skills to address H&S. The other consultants also lacked the required skills as they too could not identify the risk much earlier at the design stage. Quantity surveyors prepare bills of quantities from drawings issued to them including geotechnical reports of the construction sites. It is argued that had the quantity surveyor possessed the right skills in H&S, they too could have alerted the other parties on the project of the risk.

As for evidence of showing will and commitment to H&S by designers, it was expected that the designer would have communicated to all parties the risk and could have for example requested the main contractor for a method statement with particular reference to H&S. Approval of which could only have been granted after the designer had satisfied himself or herself with the intervention measures against the identified risk to H&S. Failure by the designer to communicate to all parties and specifically to specify or write notes to the effect that particular attention needed to be paid to excavations as they posed a H&S hazard, can be argued, is a result of a lack of capacity and willingness to address H&S on the part of designers. This view is also validated by what was observed particularly when the contractor raised concern over the safety of the excavations and proposed several alternatives in undertaking the works. The contractor's proposals included excavating wider trenches at and also to excavate in such a way that trench sides sloped at a stable angle other than the 90 degrees. Following or accepting the contractor's proposal however, meant that the cost to the project was going to be more for undertaking extra works on earthworks over and above what was budgeted. Although the designer had offered to 'help' the contractor, could not commit himself and made the problem look like it was entirely the contractor's.

The study also revealed a lack of will on the part of designers to be involved in the management of H&S. findings indicate that designers were not willing to take up the contractor's proposal or engage the client to have them understand that H&S was everyone's concern. Taking that view would obviously have placed them in a position to manage the risk as in the same way as the other project elements such as quality. This responsibility was rejected cleverly by emphasising the fact that it was the main contractor's responsibility to ensure that works proceeded in a safe manner.

#### **4.0 CONCLUSION**

From the study conducted at project XYZ, it can be concluded that designers on this project neither had the capacity nor the will to address H&S because of what was observed on the project, namely:

- H&S was not raised as an item that was very important and thus a deliverable on the project;
- Failure to realise the risk deep excavations in collapsible soil posed;
- Lack of documenting and communicating of the risk and
- Lack of H&S audits and prioritising in site meetings

Results from the study explain in part reasons why H&S performance in the construction industry is still lagging other industries. A better H&S performance is only realised with an all inclusive stakeholder participation. Some of the key stakeholders to H&S performance are designers. Literature informs that designers can influence H&S performance and therefore their role is very important. H&S should not be left to contractors alone. A better safety culture can be enforced by the active participation of designers.

It was therefore important, as part of an ongoing research project, to determine the current extent to which designers are involved in construction H&S management. The findings would in turn help in making informed decisions when determining intervention measures.



The limitation of the study is that only one project was carefully studied and therefore results can only be generalised to those projects where the client is the same. Never the less, results of the study provide an insight of what may actually be obtaining in the whole construction industry in Botswana.

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