SOUTH AFRICAN CONSTRUCTION SITES - ARE HIGH-RISK CONSTRUCTION ACTIVITIES RECEIVING THE PRIORITY THEY DESERVE?

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ABSTRACT

In the South African construction industry health and safety related risks remain unacceptably high. Arguably, this situation is largely due to ineffective hazard identification and risk management. Construction companies seem to be able to manage those hazardous site operations where the assessed risk is low, rather than diverting the necessary resources to those hazardous operations where the potential for serious injury or damage is high. The result of this mismanagement of risk is that South African construction sites remain places where serious injuries and fatalities continue to occur unabated. This paper reports on a study that sought to quantify which areas of safety and health risk management are being neglected by construction companies in the Western Cape Province. The research tool used was an audit checklist that was developed in 2004 based on the Construction Regulations (2003). The audit format aimed to objectively judge the performance of Principal Contractors relative to compliance with the requirements of the Construction Regulations. Construction related injury statistics were analysed to ascertain whether there was any relationship between the types of injuries that were prevalent and the manner in which risk categories were managed.

The findings indicate that construction companies do not allocate the necessary resources to those health and safety management areas that have the potential of causing the most serious injuries.

Keywords: Construction, Safety, Hazard, Risk, Injury

1. INTRODUCTION

The effective management of construction hazards in the form of hazardous activities and situations can be best achieved if the associated risks are properly assessed and then prioritized. Construction companies need to systematically identify those hazardous operations and activities that have the potential of causing the most serious injuries so that the necessary preventative measures can be taken to eliminate the risk of such injuries occurring. These 'high risk' operations or activities need to be prioritized so that

the necessary resources such as, time, money, safety equipment, and supervision are made available. It is believed that an objective hazard identification and risk assessment (HIRA) strategy forms the basis for effective safety and health risk management. This HIRA strategy must be initiated at the outset of the construction project and constantly reviewed as the project progresses through its various stages (Hinze, 1997).

This risk assessment process serves to clarify, *inter alia,*

- what could go wrong in terms of what injuries or damage could result;
- what are the chances of these injuries and damages occurring; and
- what the severity of the consequences are likely to be.

Once the responses to these questions are known, the necessary safety and health strategies and resources can be deployed to the hazardous operation in question so as to eliminate the risks all together or if this is not possible, to minimize the risk to below an industry acceptable level.

The research reported in this paper suggests that construction companies place insufficient emphasis on the management of site operations that have the potential of causing the most serious injuries.

2. LITERATURE

Construction remains one of the most dangerous sectors of industry (Hinze, 1997; Coble et al., 2000; Haupt, 2001) with injury rates remaining unacceptably high. The debate of what is acceptable and when an injury rate is regarded as unacceptable is a debate in itself but it is reasonable to say that the high rate of serious injuries definitely needs some serious attention. The National Safety Council (NSC) in the United States of America, found that in 1991, construction injuries accounted for 11% of all work related injures, and more than 30% of all fatalities (Vargas et. al., 1996). This alarming trend is replicated in most other parts of the world.

It is believed that too much attention is placed by construction site management on lower risk activities and operations instead of concentrating attention on the activities that have the potential of causing the most serious injuries (Hinze, 1997). Many studies suggest that hazardous activities such as:

- working at heights (including scaffolding);
- trades working directly above each other;
- working with temporary site electrical installations;
- working in close proximity to construction vehicles, mobile plant and tower cranes;
- erecting and dismantling formwork; and

- working in trenches and excavations lead to the most serious injuries on construction sites (Larsson and Field, 2002; Hinze, 1997; China Statistical Yearbook of Construction, 2001).

In fact most fatalities occur as a result of these very 'high risk' activities. It is also apparent that although there is a global decrease in construction injuries, serious injuries and fatalities remain consistently high (Khalid, 1996).

For the purpose of this paper, a serious injury in South Africa is defined in terms of the Occupational Health and Safety Act 85 of 1993 as a 'reportable injury' (Section 24 of the OHS Act), which includes:

- death;
- unconsciousness;
- loss of a limb;
- likely to die;
- permanent physical defect; and
- unable for at least 14 days, to work or continue with the activity for which worker was employed.

This paper investigates the relationship between serious injuries and the poor management of 'high risk' site activities and operations. It is evident from statistics depicting the health and safety performance of the construction sector that serious injury rates remain high and that this is a global phenomenon. Clearly, construction companies throughout the world seem to be making the same mistake of concentrating their efforts on the areas on site where the probability of injury is less and where the nature of the resulting injury is less severe.

According to Goodloe (1996), smaller construction companies are considered to have more ineffective health and safety management systems in comparison to their larger counterparts. This argument is useful and will be referred to later in the paper.

Reasons why construction companies misplace their emphasis on activities that cause the most serious injuries include:

- Not clearly identifying the causes of previous injuries on which they can base their management decisions – e.g. spending money on high risk activities that cause expensive injuries (Hinze and Gambatese, 1996);
- Top management not driving the adopted health and safety management system and not giving the site management the necessary authority to make health and safety related decisions; and
- Hazard identification and risk assessment strategies that are not properly implemented when the site work starts or have not been reviewed before new site activities begin, i.e. identifying the high-risk activities and prioritizing them.

3. RESEARCH

The objectives of this research are to:

- Identify those areas of the Construction Regulations promulgated in July, 2003 in South Africa that are not being successfully complied with and that require improved risk management strategies; and
- Examine the relationship between badly managed hazards / hazardous operations and resultant serious injuries.

The results of the research will confirm that construction companies need to assess safety and health risks in a more effective manner so that they understand what site practices have the potential of leading to the most serious injuries and major damage. The consequence of this approach will arguably lead to a reduction in serious injuries, resulting in safer, more productive and ultimately more profitable construction sites.

4. METHODOLOGY

In order to achieve the objectives of this study, a research tool was required. In 2004, a prototype construction site auditing system was developed based almost entirely on the Construction Regulations promulgated in July 2003. The premise for the audit system was that it needed to be as objective as possible and had to show Principal Contractors where they were failing to comply with the Construction Regulations so that the necessary emphasis and resources could be directed to those areas of non-compliance. The audit system was fundamentally a mechanism to gauge whether a Principal Contractor's health and safety management system was functioning as required and if not where it was falling short.

An effective and objective audit tool would ensure that the results achieved would be similar regardless of whether the audit was conducted by different auditors. A comprehensive, detailed knowledge of the Construction Regulations and practical understanding of construction health and safety are prerequisites.

The approach followed is simply that the Principal Contractor under audit begins with 100% compliance and loses points based on failure to prove conformance with the relevant regulations being scrutinized. The audit tool also includes reference to legal requirements included in other regulations promulgated under the Occupational Health and Safety Act 85 of 1993 that are not included in the Construction Regulations (2003). The results give an unparalleled overall picture of how well a particular Principal Contractor's construction site was complying with South African construction health and safety legislation. The results of construction site audits conducted between 2004 and 2007 are reported in this paper. The auditors had extensive knowledge of construction legislation and more than 12 years' practical construction health and safety experience.

Construction related injuries in the Western Cape were analysed using the injury claims data from Federated Employer's Mutual Assurance (FEMA) fund. The injuries were assessed for seriousness and cause so that a relationship, if any, could be determined between these two characteristics and then compared with the results of the construction audits. This was used to determine if the poor management of 'high risk' construction activities leads to the serious injuries continuing to occur on sites.

5. FINDINGS

The results of the EACI (E and A Continuous Improvement) audit system were extracted and analyzed. The audits were conducted over a period of three years, namely from 2005 to 2007. Fifty-one audits were conducted on 22 sites with 9 separate construction companies being involved. Most of the sites were audited more than once with 8 sites being audited more than three times during their contract period.

The audit tool

The EACI audit system as previously explained was based primarily on the requirements of the Construction Regulations (2003) and serves to measure the compliance of the Principal Contractor with the regulations. The following aspects are audited, namely:

- Written appointments
- Pressure vessels
- Risk assessments
- Scaffolding
- Fall protection (incl roof work)
- Public and site
- Structures
- Personal protective equipment
- Formwork / support work
- First aid
- Excavations
- Demolition
- Illumination
- Suspended platforms
- Housekeeping
- Materials hoists
- Electrical installations/machinery
- Batch plants
- Raising persons
- Explosive powered tools
  Supervision of construction work
- Fire hazards and precautions
- Hazardous chemical substances
- Lifting machines
- Duties of Client
- Construction vehicles and mobile plant
- Duties of Principal Contractors
- Incident management
- Supervision of construction work

The six underlined groupings were identified as hazardous construction activities/operations/areas which had the potential of causing the most serious injuries. The research was strictly limited to these six groupings as they were prevalent on most construction sites and were processes that typically ran for most of the construction period (with the exception of excavation work which is most prevalent at the commencement of a project).

It must also be noted that even though most of the sites were audited more than once, their results did not necessarily improve each time. In fact no trend could be identified indicating either a clear increase or decrease in compliance of any of the groupings. This finding seems to indicate that the Principal Contractors did not adopt an approach of compliance with the groupings in question. It can therefore be deduced that the Contractor did not see these groupings as being of a particularly high-risk nature and did not see them as a priority to direct the necessary resources to the areas/activities/operations.

Table 1 presents the results from the 51 audits carried out. The results (percentages) of the six 'high risk' groupings are shown with the final column indicating the total percentage attained taking all thirty audit groupings into account. It is apparent from the findings that the results of the six 'high-risk' groupings when averaged out are all below the average total score obtained for all the audits together. This is a clear indication that the groupings are not seen to be priority areas on the construction sites audited.

Table 1. EACI audit results

Date	Site	Company	Fall prot	Form / support	Lifting Mach	Scaffold	Elec	Excav	Audit total
01.12.05	Site 1	Audit 1	54	46	86	40	85	-	81
09.02.06		Audit 2	68	46	85	63	90	-	82
26.09.06		Audit 3	69	33	50	38	80	-	79
-	Site 2	Audit 1	40	33	77	60	75	88	77
22.11.05		Audit 2	40	46	82	100	50	-	81
11.04.06		Audit 3	65	46	96	88	45	-	82
13.03.07	Site 3	Audit 1	96	33	86	100	90	63	74
16.05.07		Audit 2	94	83	73	72	85	59	86
04.07.07		Audit 3	89	83	44	91	90	-	87
07.08.0		Audit 4	81	83	91	73	70	-	88

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10.03.05	Site 4	Audit 1	81	50	81	100	44	71	80
02.06.05		Audit 2	77	37	61	100	87	87	87
28.07.05		Audit 3	81	38	82	90	38		87
22.09.05		Audit 4	83	75	82	53	30	90	75
02.08.06	Site 5	Audit 1	94	58	61	100	90	58	88
13.10.06		Audit 2	89	75	91	44	90	100	89
06.12.06		Audit 3	89	58	91	61	90	47	87
22.02.07	Site 6	Audit 1	81	70	84	77	100	-	92
16.08.07		Audit 2	92	71	91	81	70	-	89
05.04.05	Site 7	Audit 1	91	96	93	90	100	95	97
01.06.05		Audit 2	89	100	93	100	100	100	98
10.08.05		Audit 3	92	71	88	100	95	-	95
05.10.05		Audit 4	80	71	82	85	80	-	89
15.02.06		Audit 5	71	50	70	100	80	-	87
19.04.06		Audit 6	75	79	86	90	70	-	90
14.06.06		Audit 7	89	75	91	62	70	-	-
28.10.05	Site 8	Audit 1	50	71	91	81	80	-	83
14.02.06		Audit 2	61	45	86	81	70	-	81
21.04.06		Audit 3	73	46	86	65	70	-	76
21.09.05	Site 9	Audit 1	75	33	83	70	30	44	80
23.11.05		Audit 2	62	58	84	84	90	100	76
17.08.07	Site 10	Audit 1	86	58	100	81	95	72	88

Apr ‘07	Site 11	Audit 1	79	33	77	33	40	33	79
Jun ‘07		Audit 2	86	17	94	93	50	50	86
28.08.07		Audit 3	89	-	82	77	10	100	84
06.03.07	Site 12	Audit 1	75	33	88	75	87	-	80
08.08.05	Site 13	Audit 1	38	25	82	90	80	-	76
07.02.06		Audit 2	92	83	92	90	90	-	87
08.06.05	Site 14	Audit 1	73	100	92	72	75	-	84
04.05.06	Site 15	Audit 1	75	71	100	50	95	-	87
07.03.05	Site 16	Audit 1	50	75	89	56	90	-	78
07.07.05		Audit 2	90	33	84	77	87	-	81
03.05.06	Site 17	Audit 1	64	67	63	91	95	60	75
02.02.06	Site 18	Audit 1	90	100	86	100	100	100	89
07.07.05	Site 19	Audit 1	85	42	56	75	86	-	78
02.02.06		Audit 2	63	33	83	100	95	-	79
08.02.07	Site 20	Audit 1	83	83	71	94	90	94	88
12.03.07	Site 21	Audit 1	77	-	98	-	90	-	83
06.12.06	Site 22	Audit 1	84	75	27	93	87	-	86
-		Audit 2	68	-	83	50	75	-	86
			76%	59%	80%	78%	77%	76%	82%

- Excavation work was not always taking place on the sites audited and was therefore not always scored.

The injury statistics

The injury statistics data studied indicates that there is a relationship between the six 'high-risk' groupings identified in the EACI audit results and the causes of serious injuries. This is demonstrated in the tables below. The Chinese and Turkish examples (both developing economies) compare well with the FEM (Federated Employer's Mutual Assurance fund) statistics for injuries in the Western Cape (South Africa).

Table 2. Injuries in the Chinese construction industry (1999)

Accident category	Fatality	Severe Injury
Falling from height	524 (48)	133 (44)
Electrocution	124 (11)	4 (1)
Hit by falling materials	116 (11)	45 (15)
Collapse of earthwork	148 (13)	36 (12)
Use of heavy machine	71 (6)	38 (13)
Lifting of weights	45 (4)	18 (6)
Toxic and suffocation	29 (3)	2 (1)
Use of motor	8 (1)	3 (1)
Fire and explosions	20 (2)	3 (1)
Others	12 (1)	17 (6)
Total	1097 (100)	299 (100)

The figure in parentheses indicates the percentage of the total.
Source: China Statistical Yearbook of Construction (2001), pp. 105.

Table 3. Chinese fatal injuries due to fall from height (1999)

Type	Fatality	Severe injury
Hole and edge	182 (35)	24 (18)
Scaffolding	133 (25)	51 (39)
Crane	78 (16)	13 (10)
Tower crane	35 (7)	9 (7)
Formwork	34 (6)	9 (7)
Construction machine	10 (2)	10 (7)
Earthmoving	7 (1)	3 (2)
Building demolition	7 (1)	-
Others	38 (7)	14 (10)
Total	524 (100)	133 (100)

The figure in parentheses indicates the percentage of the total.
Source: China Statistical Yearbook of Construction (2001), pp. 105.

Table 4. Statistics of injuries according to how they occur
(Turkish construction industry)

Type of injury	Fatalities	% of total
People falling	538	36.6
Material falling	139	9.5
Caving of excavations	98	6.7
Part of structure collapsing	86	5.9
Shocking by electricity	212	14.4
Injuries by construction machines	162	11.0

Source: Adapted from a paper by Mungen, 1997. Employment related accidents in the Turkish construction sector and applications of occupational safety. Health and Safety in Construction, 1997, Eds. Haupt and Rwelamila.

Mungen (1997), further categorizes falling from heights injuries in Turkey into the following (see table 5).

Table 5. Falling from heights – main causes of injuries (Turkey)

Cause	%
Falling from floors and platforms	28.1
Falling from scaffolding	23.1
Falling into holes e.g. elevator shafts	9.8
Falling from roof	9.3
Other	29.7

Source: Adapted from a paper by Mungen, 1997. Employment related accidents in the Turkish construction sector and applications of occupational safety. Health and Safety in Construction, 1997, Eds. Haupt and Rwelamila.

Federated Employer's Mutual Assurance Company (FEM), a registered workman's compensation supplier to the construction industry, keeps very reliable injury statistics. Table 6 sets out fatal injury claims by description for the Cape Town reporting region, while table 7 sets out fatal injury claims for the entire South African reporting region. It must be born in mind that not all construction companies are registered with FEM. Many companies are registered with the Government Commissioner for which recent statistical data is not readily available.

Table 6. FEM claim statistics (fatalities) – Cape Town region

Description	No. fatals (Jan–Jul '06)	No. fatals (Jan-Jul '07)
Fall onto different levels	8	2
Struck by	2	2
Caught in, on, between	2	1
Fall on same level	0	0
Other	1	0

Source: FEM statistical records 2006 and 2007

Table 7. FEM claim statistics (fatalities) – South Africa (total)

Description	No. fatals (Jan–Jul '06)	No. fatals (Jan-Jul '07)
Fall onto different levels	13	7
Struck by	11	5
Caught in, on, between	3	3
Fall on same level	0	1
Other	3	3

Source: FEM statistical records 2006 and 2007

The findings of Hinze (1996), suggest that falls from elevated positions are the most common cause of construction worker fatalities with the leading causes being:

- Off roof
- In scaffolding collapse
- Off scaffolding

A final interesting finding is that smaller construction companies are considered to have more ineffective health and safety management systems in comparison to their larger counterparts (Goodloe, 1996). Most serious injuries in fact occur on sites controlled by medium and small contractors. This information is interesting as the construction companies audited as part of this research were in the most part within the top five as far as annual turnover goes and smaller principal contractors could show even more evidence of failure to comply with 'high-risk' health and safety management requirements.

6. DISCUSSION AND CONCLUSION

In summary, this study suggests that certain hazardous activities/operations/areas on construction sites are not being optimally managed by the construction companies concerned even though there is clear evidence that these hazardous activities are causing the most serious injuries including the most fatalities in the industry.

Although the reasons for this apparent lack of focus on serious injury causing activities are not discussed in detail, the answers must certainly lie with an acceptance by company

management and decision makers that there is a clear relationship between certain 'high-risk' activities and serious injuries.

It's probably safe to say that companies need to spend their resources more effectively and concentrate more of their efforts (time, money, supervision) on these 'high-risk' activities/areas. Their site management officials (site managers, foremen, team leaders, engineers, engineering technicians and health and safety officers) need to be trained on hazard identification and risk management techniques and strategies. Site foremen must on a mandatory basis be trained on scaffold and excavation/trench safety. Team leaders/gang bosses should be included in the site health and safety system by making them responsible for hazard identification and risk management of their team and their immediate sections on site. Site personnel, including foremen and others must be disciplined for non-conformance to company and site health and safety procedures. Lastly, subcontractors must be proficient in the health and safety management of the risks associated with their particular trade/operation i.e. roofing contractors; structural steel contractors; earthworks and civil contractors; and other contractors who have to work in elevated positions to conduct their trade.

7. REFERENCES

Enshassi, A. and Mayer, P.E. 2004: "Analysis of construction site injuries in Palestine." In Rowlinson, S (ed.), *Construction safety management systems*, London: Spon Press.

Goodloe, D.W. 1996: "A prototype expert system for the evaluation of a contractor's safety program." In Coble, R.J., Issa, R. and Elliott, B. R. (eds.), *Safety and health on construction sites*, CIB publication 187

Hinze, J. 1997: *Construction Safety*, New Jersey: Prentice Hall, Inc.

Hinze, J. and Gambetese 1996: "Using injury statistics to develop accident prevention programs." In Dias, A. and Coble, R.J. (eds.), *Implementation of safety and health on construction sites*, Rotterdam: Balkema.

Khalid, G. 1996: "Construction site injuries: The case of Malaysia." In Dias, A. and Coble, R.J. (eds.), *Implementation of safety and health on construction sites*, Rotterdam: Balkema.

Mungen, U. 1997: "Employment-related accidents in the Turkish construction sector and applications of occupational safety." In Haupt, T.C. and Rwelamila, D. (eds.), Health and safety in construction: Pentech.

Rowlinson, S. 2004: "The need for accident reporting systems: legal versus company needs." In Rowlinson, S (ed.), *Construction safety management systems*, London: Spon Press.

Singh, A. and Johnson, H.M. 1997: "Fall protection analysis for workers on residential roofs." In Haupt, T.C. and Rwelamila, D. (eds.), Health and safety in construction: Pentech.

Zeng, S.X.; Tam, C.M. and Deng, Z.M. 2004: "Construction site safety in China." In Rowlinson, S (ed.), *Construction safety management systems*, London: Spon Press.