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Safety Performance on 20 Construction Sites in Dublin

Paul McEvoy
Technological University Dublin

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Dublin Institute of Technology

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Supervisor, Mr. Victor Hrymak

**Food Science & Environmental Health,
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Abstract

The aim of this research was to assess factors affecting safety performance on twenty apartment construction sites in Dublin using qualitative and quantitative risk assessment techniques.

The quantitative techniques involved observing compliance with recommended safety procedures. The qualitative techniques involved an assessment of site safety management documentation and semi structured interviews with site management regarding site safety procedures. The field work was carried out between November 2003 and October 2004.

The results showed that five sites out of twenty had high standards of safety and prevented all possible falls from heights. The five best performing sites were characterised by size of company in that that the largest construction companies were found to be the best performing. What was also found was that when a site performed well in terms of safety, it performed well across all safety categories. Evidence showing that the presence on site of a safety representative improved safety relevant to other sites was also found. The five best performing sites all had a safety representative, whilst the remaining 15 sites had a lesser number of safety representatives. However the overall number of safety representatives was too low to prove statistical significance,

Interviews with site management regarding safety standards in the construction sector over the last five years found the following. The majority of site management stated there has been large improvement in safety. However, interviewees also stated that there has been no improvement in relation to buildings being any safer to build and hence no design improvements. Furthermore the clients influence on safety as required by legislation has not improved and in some cases has lessened.

In terms of extrapolating the results against the literature the following can be stated. There has been a modest but nevertheless welcome improvement in site safety behaviour when comparing this research to comparable and previous Irish site safety research carried out in 2002.

Declaration

I certify that this thesis which I now submit for examination for the award of MPhil is entirely my own work and has not been taken from the work of others save and to the extent that such work has been cited and acknowledged within the text of my work.

This thesis was prepared according to the regulations for postgraduate studies of the the Dublin Institute of Technology and has not been submitted in whole or in part for an award in any other institute or university.

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Signature: ____________________________

(Paul Mc Evoy)

Date: ____________________________

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1.0 Introduction

1.1 Aim

- To assess the level of safety performance on twenty construction sites in Dublin.

1.2 Objectives

- To develop and implement a methodology to measure the level of health and safety performance on 20 construction sites.
- To assess factors that predicts good safety performance.
- To assess any patterns or trends in safety management on the twenty construction sites.
- To make recommendations to the construction industry based on the results.

2.0 Literature Review

2.0 Literature review:

2.1 Level of Construction Related Fatalities.

2.1.1 Introduction

Construction is one of Europe's largest industries. Unfortunately, it also has the most problematic occupational safety and health record. (Bilbao Declaration, "Building in Safety" 22 November 2004), (European agency for Safety and Health at Work, 2004).

Within the EU-15 alone the construction industry employs nearly 13 million workers Labour Force Survey (2002). In 2002 there were some 1.9 million-construction enterprises in the EU-15. Some 26 million workers in the EU depend, directly or indirectly, on the construction industry. The construction industry's annual turnover in the EU is in excess of EUR 900 billion, (European agency for Safety and Health at Work, 2004).

In the period September to November 2005 in Ireland the numbers employed in the construction continued to grow to record a new peak of 251,800 (CSO, 2005). Construction employment in Ireland now accounts for nearly 12% of the total employment nationally. The gross value of the construction industry in 2003 was €21Bn, 15% of Gross Domestic product (CIF, 2005).

In the UK the construction industry employs two million people, making it that country's biggest industry (HSE, 2004).

EU statistics on fatalities (see table 1, p4) show that fatal accidents in the construction industry have generally fallen in the last number of years, nevertheless the fatal accident rate in construction remains around twice as high as the EU sectoral average. The causes of accidents and ill health in the construction industry are well known. Falling from heights, such as scaffolding, is one of the biggest problems. According to the European Agency for Safety and Health (2004) there is a growing recognition that standards of occupational safety and health in construction has to be improved throughout the EU. A brief comment on some fatality statistics for the EU, Ireland and the UK is given below.

2.1.2 Construction Fatality Rates in EU.

Based on preliminary data from the 2001 European Statistics on Accidents at Work collected by Euro stat, fatal accidents in the construction sector fell by 29% between (1994-2001). The data also showed that there were over 1,200 fatal accidents at work in construction in the EU-15. This represented 24% of all fatal accidents at work recorded by the national authorities of the EU-15 for that year. In 2001, there were 10.4 fatalities per 100,000 workers in construction and 4.2 fatalities per 100,000 overall. According to the European Agency for Safety and Health at Work (2005) the financial yearly cost to the EU for accidents in the construction industry is estimated to exceed €75 billion a year or equivalent to €200 per person in the EU.

Table 1

(EU-15) Fatal accidents rate per 100,000 workers at work in construction, 1994-2001. (EU, 2004)

EU-15	
Year	**Fatality rate (per 100,000)**
1994	14.7
1995	14.8
1996	13.3
1997	13.1
1998	12.8
1999	11.7
2000	11.4
2001	10.4
Change in 1994-2001	-29%

The EU-15 refers to the fifteen states that formed the European Union until the end of April 2004 while the EU25 refers to the twenty five member states that formed the European Union until the end of December 2006.

2.1.3 Construction Related Fatalities in Ireland

There were 23 fatalities in the construction industry in Ireland in 2005. This is a 43.8% increase from the 16 fatalities in construction in 2004. In 2005, 32% of all fatalities occurred in the construction sector. The figures indicate that the construction sector had the highest number of fatalities in Ireland in 2004 and 2005 and was ahead of Agriculture and Forestry in terms of fatalities. In 2004 there were more fatalities in Construction (16) than Agriculture and Forestry (14). In 2005 there were (23) fatalities in construction and (17) fatalities in Agriculture and Forestry.

During the period 1995-2005 a total of 706 fatalities occurred across all work sectors in the Republic of Ireland. During the period 1995-2005 a total of 195 construction related fatalities occurred in the Republic of Ireland. These fatalities accounted for 28% of the total work related fatalities across all sectors during that time period. The year on year figures are shown in table 2 below.

Table 2

Fatalities in the construction Industry in Ireland (RoI). (H.S.A. 1995-2005).

Year	**95**	**96**	**97**	**98**	**99**	**00**	**01**	**02**	**03**	**04**	**05**	**Total**
Total Fatalities	78	59	48	70	69	70	64	61	67	48	72	706
Construction Fatalities	13	14	15	22	18	18	18	21	17	16	23	195
Construction % of overall fatalities	17%	23%	31%	31%	26%	26%	28%	34%	26%	33%	32%	28% *****

***** = Average

The number of 17 fatalities in 2003 and 16 fatalities in 2004 represented a steady decrease in the rate of fatalities in construction in Ireland. However there were 23 fatalities in construction in Ireland in 2005. This represented a sharp increase in construction fatalities in Ireland in 2005.

Table 3

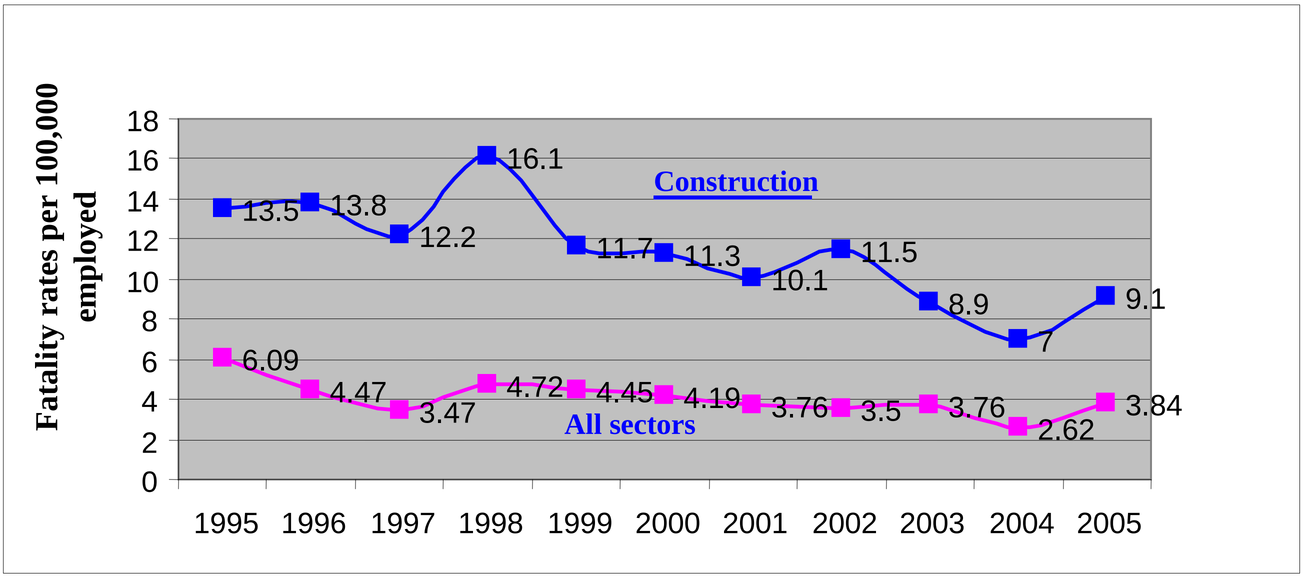
Construction and all sector fatality rates in Ireland per 100,000 employed (1995-2005)

Year	Employed in construction (CSO)	Fatalities in Construction	Fatality rate per 100,000 Construction	Total employed (CSO)	Total Fatalities all sectors	Fatalities rates per 100,000 all sectors
1995	96,600	13	13.5	1,281.7 April	78	6.09
1996	100,800	14	13.8	1,328.5 April	59	4.47
1997	122,400 Sept-Nov	15	12.2	1,379.9	48	3.47
1998	136,300 Sept-Nov	22	16.1	1,483.1	70	4.72
1999	153,800 Sept-Nov	18	11.7	1,555	69	4.45
2000	177,000 Sept-Nov	18	11.3	1,670.7	70	4.19
2001	184,300 Sept-Nov.	18	10.1	1,709.9	64	3.76
2002	190,200 Sept-Nov.	21	11.5	1,745.5	61	3.5
2003	199,500 Sept-Nov.	17	8.9	17.83.5	67	3.76
2004	226,100 Sept-Nov.	16	7	1,835.9	48	2.62
2005	251,800 Sept-Nov.	23	9.1	1,908.3	72	3.84
Total		195				

The above table shows the steady increase in the numbers employed in the construction industry in Ireland between 1995-2005. In general there has been a decrease in the numbers of fatalities per 100,000 employed during that period. However in 1998, 2002 and 2005 there was an increase in the number of fatalities per 100,000 employed when compared to the previous year.

Figure 1

Fatality rates per 100,000 for construction & all sectors 1995-2005



The above graph shows the comparison rates between construction and all sector fatality rates per 100,000 employed for the years 1995-2005. Fatality rates per 100,000 employed for the period 1995-2005 were over 2.8 times higher in construction when compared to all sectors. The average fatality rate per 100,000 employed for construction for the above period was 11.38. The average fatality rate per 100,000 employed for all sectors for the above period was 4.8. The most recent fatality rate per 100,000 employed in 2005 was 9.1 in construction and 3.84 for all sectors. The improvement rates on the average fatality rates over the above period was 20% improvement in construction and also 20% improvement for all sectors.

In general there has been a decrease in the numbers of fatalities per 100,000 employed year on year during the above period. However in 1998, 2002 and 2005 there was an increase in the number of fatalities per 100,000 employed when compared to the previous year.

The most common cause of fatalities to workers in the construction sector over the nine-year period 1991-1999 was falls from heights (49.6%). Broken down, this figure reflects falls from or through roofs (17.6%), ladders (12.0%), scaffolds (11.2%), openings or stairways (4.8%), and others (4.0%). (McDonald & Hrymak, 2002).

Survey information into fatal accidents 1995-1997: in the Construction Industry (H.S.A. 1998) revealed that the' Housing and Apartments' sector of the construction industry had the highest percentage (31%) of fatalities. Employees accounted for 63% of fatal incidents and 21% of victims had been self-employed.' General Labourers' constituted 27% of all fatalities. Almost half (46%) of fatalities reported from (H.S.A. 1997-2002) occurred on sites with between one and five workers employed. A H.S.A. review for the 10-year period 1992-2002 in the construction sector established that over one-third of fatalities on construction sites involved employees who were new to the construction sector i.e. with less than 1yrs experience. A study by the H.S.A. for the period 2004-2005 found that the rate of foreign national fatalities in the construction sector was three times higher than the rate for Irish workers (RIA, 2006).

Contribution to fatalities 1991-2001 H S A

The results replicate the 2:1:1 ratio established in the (HSE, 1992) study and the (H.S.A. 1998) study. The contributions to construction site fatalities in Ireland 1991-2001 were Site Management deficiencies contributed to 47% of fatalities while Headquarter and Injured Party issues represented 28% and 24% of fatalities respectively.

Table 4
Contributory factors to construction fatalities in Ireland 1991-2001. (H.S.A. 2003)

	N	Headquarters %	Site Management%	Injured Party%
1991-2001	132	28.31	47.35	24.34
1991	5	32.24	30.23	37.54
1992	6	16.44	57.30	26.26
1993	5	40.14	43.83	16.04
1994	5	29.18	43.86	26.96
1995	12	21.24	50.95	27.81
1996	12	23.42	48.35	28.23
1997	15	25.83	43.90	30.27
1998	15	27.44	41.96	30.59
1999	13	37.02	49.14	13.84
2000	22	33.84	45.92	20.24
2001	22	25.89	54.02	20.10

Previous research on construction fatalities revealed that supervisors were not appointed on 45% of sites where fatalities occurred between 1991 and 2001 (H.S.A. 2003**).**

2.1.4 Construction-related fatalities in the UK.

In the UK in the last 25 years, 2800 people have died from injuries received during construction work. In 2003-2004, there were 70 fatal injuries to workers in the construction industry, which was 30% of all worker fatalities (HSE).

The rate of fatal injury to workers generally fell in the 1990s until 1998-1999 but rose substantially in the two years to 2000-2001. Since then, the rate has fallen to 3.55 deaths per hundred thousand workers in 2003-2004. This is the lowest level seen in the last 12 years. The overall UK fatality rate in 2002-2003 for all workers was 227 fatalities or 0.8 (per 100,000 workers) is around a third of that recorded in 1981 (HSE).

Table 5

UK construction fatality rate per 100,000 workers. (HSE, 2005)

Year	**Fatality rate per 100,000 workers**
92/93	5.9
93/94	5.7
94/95	5.1
95/96	5.0
96/97	5.6
97/98	4.6
98/99	3.8
99/00	4.7
00/01	5.9
01/02	4.4
02/03	3.8
03/04	3.5

A report commissioned by the HSE, Brabazon et al. (2000) looked at the rate of fatalities between 1993 and 1998 in the construction industry. The report showed the scaffolding trades, roofing trades, and steel erectors as the highest risk trades for fatalities in the construction industry.

The incidents of life threatening respiratory diseases in the construction industry for the period between 1996 and 1999 are estimated to be about 200 to 300 per annum. When compared to the total number of fatal injuries due to accidents in construction industry over the same time period (236) and allied to the probable under reporting of occupational ill health, the number of fatalities in the construction industry due to ill health probably exceeds those due to injury (Brabazon et al, 2000).

Davies & Tomasin (1996) reported that 70-80% of all fatalities in the UK each year is attributed to falls. Falls from one level to another, falls on the same level and plant machinery and structures falling and striking, crushing or burying people were accounted for that percentage. On the other hand, when considering only the category "falls of people," 52% out of the 681 construction-related deaths between 1981 and 1985 were in this category (McDonald & Hrymak et al, 2002).

2.1.5 Falls from Heights.

The HSE (2002) discussion document notes that the types of incidents that lead to injuries and fatalities in the construction industry are foreseeable and preventable. "We have known for years how to prevent them, but they often happen in the same old ways". This is borne out by the finding that 'falls from heights' consistently account for almost 50% of construction fatalities. In the UK, fatalities among scaffolders, roofers and steel erectors were all above the HSE's intolerable risk criterion for the period 1993-1998 (Brabazon et al., 2000). A third of all reported fall from height incidents involve ladders and stepladders, on average this accounts for 14 deaths and 1200 major injuries to workers each year, HSE (Books, 2005).

The HSE (2002) discussion document notes that the circumstances of such incidents are not complex, usually involving a fall from scaffolding or roof, or through fragile roof materials. Enforcement actions confirm the extent of the problem – ‘scaffolding safety and unguarded openings are major factors leading to prohibition and improvement notices’ (H.S.A. 2002). The prevention of falls from heights does not require sophisticated engineered defenses. The preventative measures are simple, but remain under-utilised (H.S.A. 1991-2001). According to the HSA report (1991-2001) a total of 169 construction and construction related fatalities occurred in Ireland during the 11-year period 1991-2001. During that period almost half of all fatalities in the construction sector (74) or (44%) are attributable to falls from heights.

Table 6

Total construction & fall from height fatalities in Ireland 1991-2001. (H.S.A. 2002).

Years	**1991-2001**
Total construction fatalities	169
Falls from heights	74
Percentage of total construction fatalities	44%

Ireland, Inspection Blitz European Construction Campaign, (H.S.A 2003).

The most recent figures for the identification of activities and precautions involving falls from heights are those submitted to the (European Construction Campaign, 2003). The campaign involved inspection blitzes in June and September of 2003. A total of 425 inspections took place in Ireland during the campaign. Ireland was below the European average in terms of compliance with falls from height prevention.

Table 7

Results of inspections of European Construction Campaign 2003 into the prevention of falls from heights, (H.S.A 2003).

Year: 2003	**Ireland**	**EU Average**
	% Insufficient application	
Falls from Height	49	44

2.1.6 Summary.

Fatalities in the construction industry account for nearly 30% of the total work related fatalities in all sectors within the EU. The rate of fatalities in construction per 100,000 workers is twice that of all other work sectors. Of all the accidents in construction approximately 50% are attributed in a wide range of studies to falls from heights. Research has shown that steel erectors, roofing trades and scaffolders had a higher risk of fatal accident than other trades within the construction industry Apartments and housing sector in Ireland had the highest rates of fatalities. In Ireland nearly half of all fatalities occurred on very small sites with less than five people employed. According to the H.S.A. a third of deaths on construction sites involved employees who had less than 1 year's experience in the construction sector. Foreign worker fatalities in construction were three times more likely when compared to Irish workers. (RIA, 2006).

2.2 Level of injuries.

2.2.1 Level of injuries in Ireland

Figures released by the Central Statistics Office show that 1,374,813 workdays were lost in 2004 due to occupational injury and work related illness. According to the Health and Safety Review (2005) 100 times more days were lost in 2004 due to occupational injuries and illness than industrial disputes. The number of days lost due to injuries showed a dramatic rise of 172,000 from 2003, while the number of days lost due to illness fell by 84,000.

Construction. 2004.

The occupational injury and illness figures, which are based on the CSO's National Quarterly Household Survey show that 11,400 construction workers suffered injures and 6,300 contracted illness. The construction injury rate per 100,000 was nearly twice the all sector average.

Table 8

Injury & illness in construction and all sectors in (HSR, 2004).

	Injury	**Rate per 100,000**	**Illness**	**Rate per 100,000**
Construction	11,400	5600	6,500	3200
All Sectors.	54,000	3000	46,300	2500

Table 9

Number of persons incurring occupational injury and illness in the construction sector 2003 H.S.A (NQHS, 2003).

Number of Persons Injured		**Number of Illness cases**	
Total	+3 days	Total	
7,500	4,200	4500	

Table 10

Rate of Occupational Injury and illness per 100,000 workers in construction and all sectors 2003 H.S.A. (NQHS, 2003).

Rate of persons injured per 100,000			**Illness rate per 100,000**
	Total rate	Rate +3 days	Total
Construction	3980	2230	2390
All sectors Average.	2430	1180	2150

According to the H.S.A. annual reports 2001-2003 the most common type of incident resulting in injury was incurred while handling, lifting or carrying. This type of incident accounted for nearly a quarter of all injuries sustained. The top five incidents accounted for on average over 80% of all injuries over the three-year period.

Table 11

Incident type resulting in injury in construction over the 3 year period (H.S.A. 2001-2003).

Incident Type	Construction Percentage Incident type			
	2003	2002	2001	Average Incident rate
Injury while handling, lifting or carrying	24.6%	22.5%	27.3%	24.13%
Slips, trips & falls on the same level	26.8%	19.1%	22.3%	22.73%
Fall from height	13.6%	15.5%	16.3%	15.13%
Injury by falling objects	9%	9.2%	10.8%	9.66%
Injury by hand tools	9.4%	9.6%	8.1%	9.03%
Total Percentage	83.4%	75.9%	84.8%	80.68%

According to the H.S.A. annual reports 2001-2003 the most frequent victim body part injured was the knee joint, lower leg and ankle. This was followed closely by back and spinal injury.

Table 12

Most frequent body parts injured in construction over the 3 year period (H.S.A. 2001-2003).

Victim body part Injured	**Percentage body part Injured**			
Construction	2003	2002	2001	Average body part injured rate
Knee joint, lower leg, ankle area	16.7%	17.5%	15.4%	16.53%
Back, spine	16.7%	15.5%	16.5%	16.23%
Fingers 1 or more	14.2%	13.6%	13.4%	13.73%
Hand	9.5%	10.25	8.2%	9.3%
Lower arm, wrist	7.8%	7.9%	7.6%	7.76%
Total Percentage	64.9%	64.7%	61.1%	63.5%

According to the H.S.A. annual reports 2001-2003 the most frequent injury type sustained during the period 2001-2003 was injury to the spine and torn ligaments. This was followed closely by a closed fracture injury. The top five injury types sustained during the above 3-year period accounted on average to 81.5% of all the injury types sustained.

Table 13

Most frequent injury type sustained in construction over the 3 year period (H.S.A. 2001-2003).

Injury Type	**Percentage Injury type**			
Construction	**2003**	**2002**	**2001**	**Average Injury rate**
Spine, torn ligaments	24.9%	19.1%	24.1%	22.7%
Closed fracture	21.4%	14.8%	26.8%	21%
Bruising, contusion	19.3%	17.1%	18.3%	18.2%
Open wound	16.9%	13.7%	17.4%	16%
Abrasion, graze	4.4^	2.4%	4%	3.6%
Total Percentage	86.9%	67.1%	90.6%	81.5%

Table 14 includes all injuries with more than 3 days absence reported by employers to the Health and Safety Authority where the age was recorded. The construction sector had a relatively high number of reported injuries in the 20-24-age group compared to the all sector average.

Table 14

All injuries with more than 3 day's absence reported by employers to the H.S.A. where age was recorded (H.S.A.2003).

Age Range	Construction % Reported	All Sectors % Reported
15-19	7.4	4.1
20-24	21	13.2
25-29	14.5	16.4
30-34	16.6	15.6
35-39	12.9	13.9
40-44	7.6	12.1
45-49	8.7	9.5
50-54	5.8	7.7
55-59	3.5	4.8
60-64	1.5	2.1

Table 15 below shows the Central Statistics Office CSO figures for the number of days lost through occupational injury and illness in the construction industry and all sectors for the years 2002-2003.

Table 15

Days lost through occupational injury & illness in construction & all sectors (CSO-HSR, 2002-2003).

	Construction		**All Sectors**	
	2002	2003	2002	2003
Employed	183,200	188,500	1,745,500	1,828,900
Days lost due to Injury	113,800	99,400	857,300	610,400
Days lost due to Illness	103,100	97,000	583,700	675,700
Total days lost	216,900	196,400	1,441,000	1,286,100
Days lost per 100,000 employed people	118,395	95,977	82,555	70,422

Table 16 shows the results of the Labour Force Survey for the years from 1992 to 1997. It also compares the occupational injury rate per 100,000 at work in construction against the all sector average.

Table 16

Labour Force Survey 1992-1997 for 3 days injury rate per 100,000 in construction and all sectors

Construction Sector	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**
Employment	74,000	70,800	77,900	82,800	86,700	96,700
Occupational Injuries for persons at work (3 days lost)	1,200	1,300	1,200	1,500	1,500	1,900
Occupational Injury (Rate per 100,000 at work)						
Construction	1,622	1,836	1,540	1,812	1,730	1,965
All sector average.	961	1,207	1,162	1,082	1,272	1,240

2.2.2 Levels of injury in the EU.

According to the European Survey of Working Conditions (2000) construction workers report an average of 7.3 days of illness absence from work during the year. Of the total days of illness absence from work 32% are due to accidents at work, 28% to non-accidental work-related health problems and 40% to non-work related health problems. If applied to the 12.7 million workforces in construction, these figures mean that 30 million days are lost each year because of accidents at work and 26 million days are lost due to other work-related health problems. The EU 15 refers to the fifteen countries that formed the European Union until the end of April 2004 while EU 25 refers to the current 25 member states.

Table 17

Total days lost in construction in EU-15 due to injury and ill health. (European Survey of Working Conditions, 2000).

EU-15 Construction (2000)	
Employed	12.7 million
Injury	30 million
Ill health	26 million
Total days lost	56 million

Table 18 shows the preliminary data from the European Statistics on Accidents at Work (2001) show that there were about 822,000 accidents at work with more than 3 days lost in construction in the EU 15. These figures represent 18% of non-fatal accidents at work recorded by the national authorities of the EU-15 that year.

Table 18

EU-15 accidents greater than 3 days in construction and all sectors, (European Statistics on Accidents at Work, 2001).

2001	Construction	All Sectors
>3 days	822,000	4,566,666
Percentage	18%	100%

In the construction industry sector, the incidence rate (EU-15 + Norway) of nonfatal accidents at work is the highest in small and medium sized local units, 9,000 per 100,000 in units with 1-9 workers. 9,500 in those with 10-49 workers, 6,300 in those with 50-249 workers, and 5000 in those with at least 250 workers.

Table 19

EU-15 + Norway non fatal accidents per 100,000 workers as per unit size

Unit size	Non fatal accidents per 100,000
1-9 workers	9000
10-49 workers	9500
50-249 workers	6300
250 + workers	5000

Table 20 shows the non-fatal incident rate per 100,000 construction workers within the EU-15 between the years 1994-2001. During the period 1994-2001 there was a 20% reduction in the non-fatal incidence rate per 100,000 construction workers.

Table 20

The EU-15 non-fatal incidence rate per 100,000 workers and percentage change between (1994-2001), (EU, 2004).

EU-15	**Construction Per 100,000 workers**
1994	9014
1995	9080
1996	8023
1997	7963
1998	8008
1999	7809
2000	7548
2001	7213
Change in 1994-2001	-20%

According to the European Survey of Working Conditions (2000) construction has the highest prevalence of workers feeling that their health is at risk of injury because of work (19%) as compared to (7%) of all workers feeling so.

Table 21

The EU-15 construction and all sectors percentage of prevalence of workers feeling that their health is at risk of injury because of their work, (European Survey of Working Conditions, 2000).

2000 EU-15	**Construction**	**All Sectors**
Feeling their health is at risk of injury on account of their work	19%	7%

2.2.3 Levels of injury in construction in the UK

Self-reported work related ill health prevalence in Great Britain stood at 2.3 million people in 2001-2002, accounting for 33m working days lost. Musculoskeletal disorders (such as back pain and upper limb disorders) were the most commonly reported work related illness, with an estimated 1.1 million people affected. (H.S.E. 2002-2003).

Table 22 shows the Self-reported Work-related Illness survey in 2001-2002 estimated that 137,000 people whose current or most recent job in the last 8 years was in the construction industry suffered from an illness that they believe was caused or made worse by this job. Table 23 shows the corresponding prevalence rate, 5600 per 100,000 people working in the last 8 years, was statistically higher than the 4300 per 100,000 for all industries.

Table 22

The U.K self-reported work related illness for construction and the rate per 100,000 for 2001/2002 (SWI) survey (HSE, 2001-2002).

2001/02	**Construction**
Illness	137,000
Rate per 100,000	5600

Table 23

A comparison of the average prevalence rate of work related illness for those whose current or most recent job (in the last 8 years) was construction as compared to all sectors. (HSE, 2001-2002).

2001-2002 The average prevalence rate of work related illness per 100,000		
2001-2002 UK	Construction	All Sectors
Per 100,000	5600	4300

Working days lost in UK construction 2001/2002

An estimated 2.8 million working days were lost in 2001-2002 due to an illness caused or made worse by a current or most recent job in construction (HSE, 2004).

Table 24

Work days lost in the construction sector in the U.K. (H.S.E. 2001-2002).

Work days lost	**2001/2002**
Construction	2.8 million

Table 25 shows the comparison between the UK and the EU in relation to more than 3 days lost in construction per 100,000 employed.

Table 25

Greater than three day's absence in construction in U.K and EU per 100,000 employed for (HSE / EU. 2000-2001).

UK (2000/01)	**EU**
Greater than 3 days	Greater than 3 days
2580	7548

Musculoskeletal disorders

The construction sector has one of the higher self-reported prevalence rates for musculoskeletal disorders, mostly from manual handling: 3.6% compared to the all industries average of 2%. The Self-reported Work-related illness Survey in 2000-2001 estimated that 88,000 people whose current or most recent job in the last 8 years was in construction suffered from a musculoskeletal disorder ascribed to that job in 2000-2001. The prevalence of musculoskeletal disorders mainly affecting the back was 44,000 and of those mainly affecting the upper limbs or neck was 26,000.

Table 26

Musculoskeletal disorders, mostly from manual handling in the UK construction sector (HSE, 2000-2001).

2000-2001	**Rate per 100,000**	**Number of people affected**	**Affecting the back**	**Affecting the neck & Upper limbs**
Construction	3600	88,000	44,000	26,000
All Sector	2000			

The medical surveillance scheme in the Health and Occupational Reporting network THOR (2000-2002) show that bricklayers & masons with an estimated incidence rate of work related musculoskeletal disorders of 39 cases per 100,000 workers per year, compared with a figure of 9 cases per 100,000 workers for all occupations. For upper limb disorders, bricklayers & masons had and estimated incidence rate of 25 cases per 100,000 workers per year, compared with 7 per 100,000 for all occupations.

Table 27

Musculoskeletal and upper limb disorders affecting bricklayers/masons and all sectors per 100,000. (HSE, 2000-2002).

(THOR) 2000-2002	**Per 100,000 workers**	
Per 100,000	Musculoskeletal disorders	Upper limb disorders
Bricklayers & Masons	39	25
All Sectors	9	7

Musculoskeletal Disease.

Table 28 presents the number of reported cases of musculoskeletal disease by trade and can be summarised as follows. Floorers had very high rates of musculoskeletal disease at 2,956 per 100,000 workers. There is also a high prevalence of musculoskeletal disease among Bricklayers / Masons & Painters / decorators. Carpenters / Joiners and Plumbers are also affected by musculoskeletal disease.

Table 28

Reported cases of Musculoskeletal disease by trade per 100,000 workers (1996-1998) (Brabazon et al, 2000).

Trade	**Per 100,000 workers**
Floorers	2,956
Bricklayer / Mason	696
Painter & Decorator	578
Carpenter / Joiner	258
Plumber	233

Respiratory disease

Table 29 presents the number of reported cases of respiratory disease by trade and can be summarised as follows. Floorers had the highest rates of respiratory disease at 1,921 per 100,000. Plumbers and carpenters/joiners had high rates of respiratory diseases, which were 1,809 and 1,526 per 100,000 workers respectively.

The rate of respiratory disease for roofers is quite high at 852 cases per 100,000 operatives. The rate of respiratory disease for plaster, roofer & bricklayers is 916, 852, and 759 per 100,000 operatives. The rate of respiratory disease for electricians is 428 cases per 100,000 operatives.

Table 29

Respiratory disease by trade per 100,000 workers 1996-1998 (Brabazon et al, 2000).

Trade	**Rate per 100,00**
Floorer	1,921
Plumber	1,809
Carpenter/Joiner	1,526
Plaster	916
Roofer	852
Bricklayer	759
Electrician	428

Skin Disease

Skin diseases include contact dermatitis, contact urticaria, follicultitis/acne, neoplasia and others. The most common of these is contact dermatitis, which accounts for over 60% of all reported cases and neoplasia, which accounts for over 30% of all reported skin disease in the construction industry. Neoplasia may be benign or malignant. The remaining skin diseases can be major illnesses but are not considered to be life threatening (Brabazon et al. 2000).

The number of reported cases of skin disease by trade and can be summarised as follows. Floorers had very high rates of skin diseases at 1,133 per 100,000 workers. This trade is exposed to chemicals or materials that give very high rates of skin and respiratory disease. Roofers again suffer very high rates of skin disease and have a rate of incidence of 600 per 100,000 workers. There is also a prevalence of skin disease among Carpenters / Joiners, Bricklayers / Masons, Painters and Plumbers.

Table 30

Skin disease by trade per 100,000 workers 1996-1998 (Brabazon et al, 2000).

Trades	Per 100,000 workers
Floorer	1,133
Roofer	605
Carpenter/ Joiner	538
Bricklayer / Mason	425
Painter decorator	386
Plumber	224

Overall conclusions.

Floorers have high incidences of musculoskeletal, respiratory, and skin disease. The roofing trade appears to be one of the most hazardous as they have quite high incidence of respiratory and skin disease (in conjunction with a high fatal injury rate). Carpenters / Joiners, Bricklayers / Masons, Painters and Plumbers are trades that suffer from respiratory, skin and musculoskeletal diseases.

Dermatitis.

Workers in construction can suffer from skin disease, particularly dermatitis due to contact with cement. The estimated annual rates of new dermatitis cases reported to dermatologists in 2000-2002 through the medical surveillance scheme in the Health and Occupational Reporting network (THOR) were 17 per 100,000 for builder/building contractors and 14 per 100,000 for bricklayers/mason, compared to the average of 7 per 100,000 for all occupations.

Table 31

New dermatitis cases reported to dermatologists per 100,000 workers in UK (HSE, 2000-2002).

2000-2002 UK	Cases per 100,000
Builder / Building contractors	17
Brick layers / Masons	14
All Sectors	7

Vibration related disorders

Construction workers also suffer from vibration related disorders due to their work with power tools. The annual rate of new cases of Vibration White Finger (VWF) assessed for compensation under the Industrial Injuries Scheme was 12.9 per 100,000 workers in 2000-2002 compared to the average of 2.2 for all industries.

Table 32

New cases of Vibration White Finger assessed for compensation per 100,000 workers 2000-2002 for construction and all sectors. (HSE, 2000-2002).

IIS (2000-2002)	**Construction**	**All Industries**
Vibration White Finger	Rate per 100,000	Rate per 100,000
	12.9	2.2

Asbestos related disease.

Asbestos-related disease. There are four main diseases associated with inhalation of asbestos fibres. These are asbestosis (a fibrosis of the lung tissue caused by asbestos) two kinds of cancer (in mesothelioma and asbestos related lung cancer) and diffuse pleural thickening (a non malignant disease affecting the lung lining), (HSE, 2004).

According to the HSE (2004) past exposures in the construction industry in the UK have led to relatively high incidence rates of asbestos related disease. In 2000-2002 the rates of new Industrial Injuries Scheme cases for mesothelioma, asbestos and diffuse pleural thickening were each at least 4 times the average rate for all industries in the UK. It is estimated that at least a quarter of all mesothelioma deaths each year arise from exposure in the construction industry.

Table 33 shows the number of Industrial Injuries Scheme disablement benefit cases of mesothelioma in the construction industry. The annual average incidence in construction for the three-year period 2000-2002 was 284 cases. This is equivalent to an annual rate of 19.9 cases per 100,000 workers, which is more than 5 times that for all industries combined (3.8 cases per 100,000 workers), (HSE, 2004).

Based on Industrial Injuries Scheme figures, the annual average incidence of asbestosis in the construction industry for the three-year period 2000-2002 was 161 cases. This is equivalent to an annual rate of 11.3 cases per 100,000 workers, which is around 5 times the rate for all industries combined (2.3 cases per 100,000 workers).

The annual average incidence of diffuse pleural thickening with the construction industry for the three-year period 2000-2002 was 122 cases. This is equivalent to an annual rate of 8.5 cases per 100,000 workers, which is nearly 6 times the rate for all industries combined (1.5 cases per 100,000 workers), (HSE, 2004).

Table 33

Cases of mesothelioma, asbestosis and pleural thickening per 100,000 workers for construction and all sectors. (HSE, 2000-2001).

Industrial Injuries Scheme (2000-2001)	Construction		All Industries	
	Average cases	Rate per 100,000	Average cases	Rate per 100,000
Mesothelioma	284	19.9	800	3.8
Asbestosis	161	11.3	492	2.3
Pleural Thickening	122	8.5	310	1.5

Work related hearing loss.

Construction workers can suffer from work related hearing loss from the tools they use and the circumstances in which they work. The estimated annual rates of new cases reported to audiologists in 2000-2002 were 4 per 100,000 for all occupations. The rate of new Industrial Injuries Scheme cases of occupational deafness was around double that for all industries (2.7 per 100,000 per year compared to 1.1), (HSE, 2000-2002).

Table 34

New cases of occupational deafness reported to audiologists per 100,000 workers for construction and all sectors in (HSE, 2000-2002).

Industrial Injuries Scheme (2000-2002)	Construction		All Industries	
	Average cases	Rate per 100,000	Average cases	Rate per 100,000
Occupational Deafness	28	2.7	251	1.1

2.3 Safety Management Systems for Construction Site Safety.

2.3.1 Introduction.

In order to reduce the level of fatalities, injury and ill-health in the construction industry, a number of safety management systems are available and itemised on table 35.

Table 35

Safety Management systems

Protocol	Status	Year of origin	Comment	Available for Certification
HSG 65 UK	Successful Health & Safety Management Initial Model developed by the UK HSE to provide OHSMS guidance	1st 1993 2nd 1997	Possibility of a new edition with more human factors guidance	Not available
BS 8800	Occupational health and safety management system-Guide. British Standards Institution, London.	1996 Revised 2004	New version published in July 2004 with significant amendments	Not Available
OHSAS 18001	Occupational Health & Safety Management Systems. Agreed specification	1999	Review in early 2005 4000 licenses issued	Available for Certification
ILO OSH	International Guidance International Labour Office, Geneva.	2001	Available as an international "guidance" for national governments, but pilot work of a wider global scope in progress	Not Available
Safe-T-Cert	Approved CIF/CEF/IOSH construction	1998	Republic of Ireland and Northern Ireland	Available for Certification

2.3.2 Safe-T-Cert.

Safety management system for the construction industry.

The Safe-T-Cert was launched in the island of Ireland October 2000. The Construction Industry Federation in Dublin and the Construction Employers Federation in Belfast developed the Safe-T-Cert jointly. The Safe-T-Cert takes account of "best practice" guidelines of relevant national and international bodies including the ILO, (Safe-T-Cert, 2005).

The Safe-T-Cert is a recognised system under the Build Safe initiative in Northern Ireland the Construction Safety Partnership in the Republic of Ireland. Only companies that have gone through a detailed certification process and have met the minimum criteria will receive certification. Companies can use Safe-T-Cert to demonstrate to clients that they have effective safety health and management systems and procedures, (Safe-T-Cert, 2005).

2.3.3 Safe System of Work Plan (SSWP)

In January 2005 the Health and Safety Authority launched a new initiative namely the H.S.A. "Safe System of Work Plan" (SSWP). H.S.A (2005) created a wordless document where safety can be communicated to all workers regardless of literacy or language skills. The (SSWP) relies heavily on pictograms to explain and clarify hazards and controls. The Safe System of Work Plan (SSWP) won the supreme innovation award for the Construction industry at the World Health and Safety Congress in Florida in 2005, (H.S.A. 2006).

Many organisations are now seeking to establish individual integrated management system within a common framework, which effectively controls the overall arrangement for safety, health, environment, quality and more recently security (SHEQS), (HSR, 2005).

2.3.4 Quality Management Systems

Mc Hugh (2003) reports on the results of research carried out on the implementation of BS EN ISO 9000 as a continuation of BS5750 in the U.K. construction industry. This paper has shown that as far as the experiences of the managers that were interviewed, "the ISO 9000 standards series can form and has formed the basis for an efficient and advantageous quality management system". Of particular importance are the reviews required for the initial registration, the requirement for regular internal audits, and reviews carried out for renewing registration.

Mc Hugh (2003) discusses the implementation of construction quality systems based on the elements of the ISO 9001 series. Each of the elements of the ISO system are described and adapted to construction safety systems, aimed at developing such systems in a systematic manner thus leading to the improvement of safety performance levels on site. This paper discusses the requirements of the safety management system, which follows the methodology and structure of the ISO 9001 series.

Mc Hugh (2003) states that the framework for implementing an EMS system for the construction industry relies on the following course of action, (Plan –Do –Check –Act). Construction companies need to investigate as to how their activity impacts on the environment. ISO 14000 must be integrated with a corporate environmental strategy. This report states that construction companies should be proactive in their approach to environmental management.

According to Koehn et al (2003) the international organisation for standardisation has not yet released ISO 18000, but it is being utilised on a national level in the UK, Australia, and Singapore. It may be considered an improved version of a safety management system (SMS) which itself is a relatively new approach of controlling safety policies, procedures and practices within a company. According to Wilson and Keohn (2000) this philosophy is currently being implemented by many construction companies to limit their liabilities and costs, thereby making them more competitive in the construction market place.

In some countries and regions such as Singapore and Hong Kong, submission of a safety management system is mandatory before starting a construction project above a particular monetary volume. In the USA the Occupational Safety & Health Administration (OSHA) mandates that employers such as contractors are responsible for providing a safe and hazard free workplace for all employees. Proper implementation of ISO 18000 (SMS) could serve the requirements of a governmental regulatory body, such as OSHA as well as provide a firm base line towards a safer working environment (OSHA, 2001).

McDonald & Hrymak (2002) stated that it is too easy to comply with legal requirements through having a paper system, which does not effectively operate in practice. This report argues that safety management systems should be audited to assess the effectiveness of safety management systems; the duties of the safety officer should be strengthened, while operational management of health & safety should be measured and held accountable.

McDonald & Hrymak (2002) found that the presence of a site safety representative showed the strongest relationship with safety compliance. They recommend that all sites should have a safety representative and 'their role and functions should be reinforced as part of the safety management system.

2.4 Interventions on building sites designed to improve safety.

2.4.1 Introduction

There are many examples of interventions on building sites designed to reduce accidents and ill health in the construction industry. The European Agency for Safety and Health at Work (2004) presents a number of examples of good practice on the prevention of risks in construction work.

NCC is a major construction and property development company in Sweden. NCC wanted to provide health and safety information to its employees in a simple, non-verbal format. NCC developed a picture book presenting different hazardous work situations - the Silent Book - containing pictures of what not to do and what to do.

The Silent Book was distributed to all the company's employees in Sweden and in other countries. As the booklet was pictorial, there were no translation problems.
NCC's work-related accident rate has declined over a ten-year period. The Silent Book has played an important part of NCC's overall policy and actions to promote health and safety improvements. According to the European Agency for Safety and Health at Work the Silent Book is an excellent way of providing information to everyone. The Silent Book is particularly suitable for those employees who not speak the language of the country they live in, and for anyone who cannot read with confidence, (European Agency for Safety and Health at Work, 2004)

One aspect of poor safety management in Finland has been the absence of tools for reliably monitoring occupational safety. In 1992 and 1993, the Occupational Safety and Health Inspectorate of Uusimaa, in cooperation with the Finnish Institute of Occupational Health, developed a method for evaluating the occupational safety level on construction sites, the 'TR method'**.**

The 'MVR method' was later developed for the civil engineering sector. Important features of these methods are that they are simple, and the process is carried out with both employer and employee acting together, thereby ensuring effective cooperation.

A competition was launched in Finland in 2001 to improve safety in the construction industry. The TR and the MVR methods were used as safety performance tools in the competition. Results show that in the past 4 years, accident frequency has fallen by 20% in the competing companies. According to a scientific study on the TR' method, it is estimated that, because of the competition, the competing companies have as many as 500 fewer accidents every year, (European Agency for Safety and Health at Work, 2004)

Construction firms in Austria held discussions to identify ways to improve safety when erecting and dismantling scaffolding to reduce the risk of serious accidents due to falls from heights. The result of these discussions was that if an easy-to-use, ready assembled, scaffolding system with corresponding anchorage parts and fittings were developed there would be considerable benefits.

Results found that by using "Ready Assembled Scaffolding" compared to the erection of traditional scaffolding the risk of serious accidents due to falls from heights is decisively reduced, (European Agency for Safety and Health at Work, 2004)

Johnson, et al (1998) carried out research for the Hawaii Occupational Safety and Health Division into the protection of residential roof workers from falls. A number of recommendations offered for improving the protection of residential roof workers from falls are summarised below.

- Reduce the complexity of the regulations.
- Provide incentives for compliance. For example, discounts for workers, fall protection equipment subsidies and tax credits.
- Require special permits for renovations and home repair. Increase involvement from risk managers or owners. Make licensing requirement more stringent. Increase the amount of fines issued.
- Develop a co-operative education program for contractors and workers alike. Provide training in hazard analysis and the hierarchy of fall protection, Provide certification of safe work practices that would allow for reduced regulatory inspections.

- Improve the safety culture at all levels, from the worker to the developer to the individual homeowner.
- Finally, innovative methods of protecting the workers must be developed. An independent hazard analysis should be conducted for each phase of construction, to determine appropriate methods of fall prevention or protection.

The HSE in 1993 commissioned a two year study into construction site safety. The research findings showed that the best performing sites overall were those where management attended all the meetings with operatives at the commencement of the intervention. These findings are also broadly in line with an overview of a variety of managerial interventions. Rodgers et al. (1993) found that "studies have consistently reported that commitment from top management is essential" for an intervention to succeed (Marsh, 1995).

This research examined the relationship between management commitment, the safety climate and safe work behaviour in construction site environments in Australia in 2002. The empirical results indicate a significant relationship between the safety climate and safe work behaviour. Management's commitment is a central element of the safety climate (Zohar, 1980). Management's role has to go beyond organizing and providing safety policies and working instructions. Langford et al. (2000) found that when employees believe that the management cares about their personal safety, they are more willing to cooperate to improve safety performance.

Positive safety climates seem to result from management's showing a committed and non-punitive approach to safety. Positive safety climates seem to result from management promoting a more open, free-flowing exchange about safety-related issues. The result of this research verifies previous research (Zohar, 1980) and further emphasises the importance of managers being committed to and personally involved in safety activities to emphasise safety issues within the organisation, (Mohamed, 2002).

Researchers from Purdue University's School of Health Sciences, Indiana, USA. conducted a study to determine what elements of the safety programmes of large construction companies were responsible for a reduced rate of falls in comparison to

small construction companies (Construction Safety Alliance, 2003) The results can be summed with three terms: motivation, training and money. The primary reason for the success of large construction companies at reducing construction falls is that upper management has made commitment to be safe, (Abraham et al, 2004).
Abraham et al (2004) showing that the rate of falls decreased as the cost of construction projects increased.

Research was carried out into the risk of falls from heights for small construction companies with less than 20 employees in Australia. Lingard et al (2001) cited previous research, small businesses are characterised by poor management skills, Jones et al (1998) and authoritarian management styles, (Orlandi, 1986), (Witte 1993). Small businesses are poorer at implementing OHS programmes than larger businesses (Hollander and Lengermann, 1988), (Fielding and Piserchia, 1989) (Eakins, 1992) (Holmes, 1995) and (Mayhew, 1995). Small businesses are characterised by poorer communication between employees and management on OHS (Williams, 1991) and (Rundmo, 1994). The results of the research suggest that at the small construction companies there is a fatalistic resignation to OHS being an unavoidable part of the job. This in turn leads to an emphasise on individual rather than technological control for OHS risks, (Lingard et al, 2001).

Research was carried out to evaluate factors affecting safety performance levels on three construction sites in the Rep. of Ireland. Mc Hugh (2003) found that the safety management system was the most likely explanation of better safety performance on site three when compared with site one and two. Whilst a safety management system might not necessarily explain the improved safety performance levels on site three the wider literature would support this view.

Mc Hugh (2003) reported that Health and safety management systems when properly implemented have been identified as an important intervention to maintain high levels of compliance, (Landin et al, 1999) and (Kievani et al, 1999) comment on quality management systems that have been implemented in the construction industry while, (Zhang et a,. 1999) comments on an appropriate framework for the implementation of an environmental management system.

The HSE (1992) argued that poor safety performance levels in the construction industry can often be traced back to management of health and safety issues. The H.S.A. (2001) comments that good practice in health and safety management and consultation is a key element of preventing injuries and ill health in the work place.

Whilst this management system may be in itself a manifestation of management commitment (Booth and Lee, 1995) the importance of managing safety has been clearly cited in the literature.

Mc Donald & Hrymak et al (2001) carried out research into the factors that influence safety behaviour and compliance with safety requirements on construction sites. This research found that the strongest relationship with the main safety compliance factor was with the presence or absence of a safety representative. A safety representative on site was associated with better compliance. The presence of a safety representative was the only factor, which is significantly related to safety behaviours. Safety representatives are associated with a greater likelihood of reporting risky situations and a lower likelihood of simply continuing working in such situations. The presence of a safety representative are also strongly related to the effectiveness of response to audits and reported hazards. This pattern of relationships suggests that safety representatives are the most important influence on the association between effectiveness of response to audits and hazards and safety compliance.

The safety representative variable was also the only variable that shows a significant relationship with reported safety behaviours–specifically reporting hazards and not continuing to work in hazardous situations. Thus safety representatives encourage the reporting of hazards and play the major role in ensuring that these reports lead to better safety compliance on site. Their presence also makes it significantly more likely that workers will not continue to work in hazardous situations.
The study recommends that all sites should have safety representatives and their role and functions should be reinforced as part of the safety management system.

Abraham et al (2004) identified 17 contract provisions that were important for project safety. One provision (contained in 83% of the contracts) was the requirement that the contractor must assign at least one full-time safety representative to the construction site.

Jaselskis et al (1996) found that to achieve outstanding project safety performance field safety representatives should spend 30-40% of their time on safety issues. Expending less time may compromise the project safety outcome.

Jaselskis et al (1996) through an analysis of construction companies and project safety performance in the USA identified specific factors that are significant in improving safety performance. These factors are summarised below.

"Upper management attitude"
Strengthen upper management's attitude toward the importance of safety. Projects that achieve average and outstanding project stature had strong upper-management support compared to below average projects where management support was weaker.

"Project management team turnover"
Reduce project-management team turnover as much as possible. Outstanding projects experienced lower turnover rates (3.8%) compared to average or below average projects (9.6%). This suggests that team stability plays a role in achieving better safety performance.

"Time devoted to safety by field safety representatives".
Field safety representatives should spend 30-40% of their time on safety issues. Spending less time may compromise the project safety outcome.

"Number of formal safety meetings with supervisors".
Increase the number of formal safety meetings with supervisors to one per week. Outstanding projects averaged 3.5 meetings per month, compared to 2.6 for below average and average projects.

"Number of informal safety meetings with supervisors".
Increase the number of informal safety meetings with supervisors to 6 per month. Below average and average projects experienced about four meetings per month.)

"Site safety inspections"

Increase informal site safety inspections to four per week. Below average and average projects averaged approximately 1.5 informal inspections per week.

"Worker safety performance fines"

Consider reducing the amount of money fined to workers who exhibit poor safety performance. Outstanding projects fined workers an average of $13 pre violation compared to $82 for below average and average projects. This suggests that workers respond better to positive approaches when trying to comply with company safety policies (Jaselskis, et al, 1996).

Marsh et al (1995) carried out research on improving safety behaviour using goal setting and feedback on 13 building sites in the north west of England. Marsh et al (1995) review of research on feedback demonstrates that performance is enhanced when management provides clear feedback of performance-related information. These techniques for modifying behaviour have already been shown to be of value in safety. McAfee and Winn (1989) for example, showed that systematically monitoring safety-related behaviour and providing feedback in conjunction with goal setting and or training could improve safety behaviour in construction. Chookar and Wallin (1984) demonstrated how safety performance with feedback and goal setting was better than with only goal setting in a study of metal fabrication workers. Reber and Wallin (1984) found similar results in a study of machine manufactures.

This research finding showed that goal setting and feedback can be used to produce significant improvements in safety performance. This finding is consistent with and adds to the findings of (Mattila and Hvodynmaa, 1988) in suggesting that the use of goal setting and feedback techniques can significantly improve safety behaviour on building sites.

In the Nevada survey only four respondents did not have a drug-testing program. The injury rate for these contractors was considerably higher than the injury rate reported by the firms with drug testing programs. For the Florida roofing contractors, the drug tests that were associated with better safety performance were those conducted for reasonable cause. These are tests that are deemed, necessary because of a worker's appearance or demeanour that suggests drug abuse. It should be noted that only a few firms did not conduct tests for reasonable cause, but these had a particularly high injury rate. Those that did not conduct post accident drug testing had significantly higher injury rates (Hinze et al, 2003).

Most firms surveyed had some form of drug testing in place. These tests included random tests, tests for reasonable cause, post accident tests, and follow-up testing. All did show that for at least one type of drug test, injury performance was favourably impacted. No evidence suggests that drug testing is not effective in reducing injuries, (Hinze et al, 2003)

The research of Garza et al (1998) and sponsored by Construction Industry Institute CII in the USA analysed the different OSHA incident rates for construction contractors who keep track of accidents versus those contractors who do not. Garza et al (1998) analyses of those contractors who do not keep accident records by project, averaged incident rates, which are about double those rates found in companies that do keep these records by project. Levitt and Parker (1976) performed a study examining the difference in accident rates for those contractors that keep records of accidents by project to those that do not. The findings of this Construction Industry Institute study are very similar to (Levitt and Parker's, 1976) findings in some ways. They, too, saw that the accident rates for contractors that keep records of accidents by project were substantially lower than those of the companies that do not keep these records. Levitt and Parker (1976) quoted by (Garza, 1998) qualified their results by stating that keeping such records can only be effective if top management is aware of the existence of the records. The records produce results only if top management uses them in evaluating superintendents and foremen. In essence, they found that success is gained through measurement and implementation (Levitt and Parker, 1976). This verified finding clearly confirms, "What gets measured gets improved".

Recommendations to reducing compensation and injury claims in construction, Garza et al (1998).

- Avoid using a single indictor as a measure of contractor's safety performance. Instead, use the collective criteria formed by the contractor's (EMR), The

Experience Modification Rate, (RIR) Recordable Incident Rate, (LTIR), Lost Time Incident Rate, (WCCFI) Workers Compensation Claims Frequency Indicator and its explicit commitment to zero-injuries.

- Educate employees, employers and employee representatives about workers' compensation and its impact on business.
- Participate in the selection of medical providers, focusing on those who believe in getting the injured worker back to work as soon as is medically practical.
- Utilize modified work programs for injured employees where they can perform productive duties without exposing them or their co-workers to further injury.
- Take an active role in interfacing with the insurance carrier or provider.
- Participate in validating, approving, or denying employees' workers' compensation claims, including vigorous opposition and investigation of suspected fraud.
- Maintain frequent contact with injured employees. Make sure their needs and expectations are being met and keep them abreast of jobsite activities.
- Establish accountability for workers' compensation costs with projects and supervisors.
- Provide on-site first aid treatment appropriate to the size of the project.

Harper et al (1998) research highlights some of the areas addressed by Mason Construction, Inc. Texas in the establishment of their safety programme, including increased employee involvement. Mason Construction, Inc. is a contractor with approximately $15 million annual revenue in the civil sector of the petrochemical industry of southeast Texas. Mason Construction, Inc was also a recipient of the 1997 Construction Industry Safety Excellence (CISE) Award, which was presented by the National Business Roundtable. Mason was one of only 11 companies in the nation to win this prestigious award.

Specifically, the principal manner in which Mason has overcome the management burden is through increased employee involvement in all phases of site safety. It is generally known that employees are often more aware of hazards in the work place than are employers (Koehn and Surabhi, 1996). By involving the employee in the safety process, more commitment is gained from the employee. This additional commitment may be attributable to the employee's desire to execute something, which he or she has developed or assisted in developing. This type of involvement enables the employees to gain a sense of ownership and increased responsibility.

Employees are more apt to accept and adapt to minor changes implemented into a safety programme through time than they are to accept vast changes thrown upon them at short notice (Paterson, 1996).

Again employee involvement is key here. In most instances it is the employees who are most knowledgeable about the potential hazards peculiar to their work as well as ways to avoid these hazards. Management need only tap this knowledge held by the employees. Also, with employee involvement changes may be made much more efficiently than by forced implementation with no input from the employees.

Contemporary theories of accident prevention hold that in order to behave safely people need to possess the knowledge, skills, and abilities (KSAs) and the motivation to do so. Lingard (2002) (Furnham, 1994), (Lindell, 1994), (Goldstein, 1993) observed a low correlation between learning an ability to do something and actual job behaviour.

Marsh et al (1995) reported that the role of the observer on site seems to be of vital importance. Two factors are particularly interesting. First the role of the psychological make up of the observer. Second the position within the organisation that the observer holds. Marsh et al (1995) found that good observers do not need to be either "safety experts" or site management. Some, of the most efficient observers have been operatives and trainee foremen. The duties involved require conscientiousness and a methodical approach. Outstanding intellectual quality is, not important as the fundamental philosophies that underpin the intervention are basic and easy to grasp. It appears to help the observer if he or she has a good rapport with the operatives. Ideally at least two fully trained observers are required on each site, (Marsh et al, 1995).

The principal objective of first aid training is to provide laypersons with the skills to assist a casualty, before the arrival of specialist medical help, in the event of injury or sudden illness. However research has shown that when administered in a work setting, first aid training has a secondary effect of improving occupational health and safety performance. For example, Lingard (2001), (Miller and Agnew, 1973), and (Mc Kenna and Hale, 1981) found an association between traditional first aid training and a lower incidence of workplace injuries. Lingard (2001) found that first aid training had a positive and significant effect on certain aspects of the construction workers behaviour.

Kashiwagi (2004) research in the USA proposed that quality performance and safety issues are not a construction or engineering issue, but a business issue of supply and demand. This $4 million research programme at Arizona University provides evidence that the owner (and not the construction industry) has more impact on the level of construction performance. It concludes that the relationship between the owner's approach to construction and the level of performance (quality and safety, on time, and on budget) is driven by the ability of the owner to efficiently demand performance. If the owner out sources construction properly, by passing the risk of performance to the contractor, the contractor is more likely to send highly trained personnel who can perform on the project (and who are safe). The construction industry's performance has shown that when the owner identifies minimum standards, contractors have supplied the minimum level of performance. This research shows that when the owner properly identifies and demands performance through correct outsourcing, the level of performance of construction is extremely high (Kashiwagi, 2004).

Saurin (2004) reported that in the USA, (Hinze, 2002) and (Liska et al, 1993) have consistently found that pre-project and pre-task safety planning are among the critical measures required to achieve a zero accident target. Lingard (2001) reported that (King and Hudson, 1985) research suggested that the inclusion of safety costs in a tender reduces the loss time accident frequency rates from a range of 2.5-6.0 per 100,000 man hours worked to a range of 0.2-1.0 per 100,000 man hours worked on major construction projects

Abraham (2004) in this research identified three principal areas in which facility owners can and do influence safety performance on construction projects citing (Hinze, 2003). These include the

- Selection of safe contractors,
- Carefully drafted contract documents.
- Active involvement in safety during construction.

Abraham (2004) examined contract requirements found in all contracts which were perhaps the foundation for project safety. The following list contains 17 contract provisions on safety that were examined. These contract provisions state the contractor must:

- Comply with local, state and federal safety regulations.
- Comply with safety requirements beyond the OSHA regulations.
- Place at least one full-time safety representative on the project.
- Submit the résumés of key safety personnel for owner's approval.
- Provide specified minimum training for the workers.
- Report all lost time injuries to the owner.
- Report all OSHA recordable injuries to he owner.
- Report all (including first aid) injuries to the owner.
- Include owner personnel in coordination meetings.
- Submit subcontractor list for owner approval.
- Implement a substance abuse programme.
- Participate in site safety inspections.
- Conduct weekly safety meetings.
- Submit a site-specific safety plan.
- Submit a safety policy signed by its CEO.
- Provide specified PPE (hard hats, safety glasses, gloves).
- Implement a permit system for hazardous activities (line breaks, lockout/tagout, excavations, proximity to power lines, confined space entry, hot work etc.).

One provision (contained in 83% of the contracts) related to notable improvements in safety was the requirement that the contractor must assign at least one full-time safety representative to the construction site (Abraham et al, 2004).

Harper et al (1998) in this case study shows that the benefits attributable to a strong safety program outweigh the costs of the program itself. Specific steps taken by Mason Construction, Inc. in Texas to reduce its risks of accidents and increase worker safety included,

- Better safety management.
- Hazard awareness through safety training.
- Employee involvement.
- Good housekeeping procedures.
- Reduction in labour turnover rates.
- Emphasis on safe work methods and procedures.

The reduction in work accidents seen by Mason Construction, Inc. has been substantial since the inception of its current safety program, implemented in 1992. This reduction in accidents has led to lower incidence rates, a lower experience modification rate, reduced worker's compensation insurance rates, and a decreased in monetary losses from legal fees associated with worker's compensation claims. Additionally reduced loss time has lead directly to increased productivity.

Since implementation of its comprehensive safety program in 1992, which received further enhancement and development in 1994, Mason Construction, Inc. has enjoyed an overall decreasing incidence rate, which has fallen from 7.75 in 1992 to a rating of zero in 1996. Comparatively, the industry average for SIC code 162 (Heavy construction, except highway) under which Mason Construction is categorized was 11.4 in 1992 and had decreased only slightly to a low of 9.4 in 1995.

Overall, since the inception of Mason's current safety program the company has spent roughly $545.000 on safety-related issues. Of this, approximately $177,000 was directly spent on the implementation and management of its safety program. Total returns stemming from the safety program and reduced worker accidents have been approximately $956.000 since 1992, with approximately $654.300 of this savings from insurance premiums alone. In particular, the ratio of the dollars returned to each dollar invested in safety may be calculated to be 1.754.

As of March 1997 Mason Construction, Inc. employees had worked a total of 557,770 man-hours without a lost time accident and 447,035 man-hours with no recordable incidents.

Young (1996) The Business Roundtable took the lead in the 1980s by recognizing that improving construction safety performance is essential to improving the cost-effectiveness and competitiveness of the U.S. construction industry. Their reports clearly demonstrate how poor safety performance increase insurance costs as well as indirect costs like lost productivity, schedule delays and adverse public relations. Savings are maximised only by cost effective investment in management controls.

The Los Angeles Metro project began with a single safety professional in the construction manager's organization. After five years of negative publicity concerning safety issues, the project's managers increased their investment in safety by approximately tenfold. The Washington Metro project also increased staff and implemented a financial incentive program for contractors that have been credited with saving $10 million per year (Young, 1996).
The Denver International Airport expanded its safety management staff from 6 to 39 people and realized a corresponding fourfold decrease in the cost of claims per hour worked. Although some argue that the staffing increased was an overreaction to two earlier fatalities, the investment resulted in improved performance. After three years, the public officials managing the project could claim savings of approximately $35 million. (Young, 1996).

Gambatese, et al (1997) looked at a study by the Construction Industry Institute which focused on creating a database of safety ideas and a design tool that allows designers to address construction worker safety in their designs. Four hundred design suggestions have been accumulated in this research. The design tool will be useful not only for improving safety during the construction phase of the project, but also during the start-up and maintenance phases. The design suggestions reflect all types of design disciplines and construction hazards with the majority or 32.8% relating to falls. Many falls on construction sites occur due to the architectural and structural scope of work, the design of beams, columns, walls, stairways and ladders etc.

The following is an example of the design for safety suggestions in relation to fall prevention.

- Suggestion, Design components to facilitate prefabrication in the shop or on the ground so that they may be erected in place as completed assemblies.
- Purpose, reduces worker exposure to falls from elevations and the risk of workers being struck by falling objects.
- Suggestions, design steel columns with holes in the web at 0.53 and 1.07 m above the floor level to provide support locations for guardrails and lifelines.
- Purpose, by eliminating the need to connect special guardrail or lifeline connections, such fabrication derails will facilitate worker safety immediately upon erection of the columns.
- Suggestion, design beam to column double connections to have continual support for the beams during the connection process by adding a beam seat, extra bolt hold, or other redundant connection point.
- Purpose, continuing support for beams during erection will eliminate falls due to unexpected vibrations, misalignment, and unexpected construction loads.
- Suggestions, minimise the number of offsets in the building plan and make the offsets a consistent size and as large as possible.
- Purpose, prevent fall hazards by simplifying the work area for construction workers.

3 Methodology

3.1. Aim

3.2 Objectives.

3.0 Methodology.

3.1 Introduction.

The methodology adopted was based on the Mc Donald & Hrymak (2002) research. Similar methodologies have been used successfully to measure construction site safety by the Health and Safety Executive, (HSE, 1999).

Aim

- To assess the level of safety performance on twenty construction sites in Dublin.

Objectives

- To develop and implement a methodology to measure the level of health and safety performance on 20 construction sites.
- To assess any factors that predicts good safety performance.
- To assess any patterns or trends in safety management on the twenty construction sites.
- To make recommendations to the construction industry based on the results.

The methodologies used were:

1. Construction site safety observational checklist
2. Construction site documentation checklist and analysis
3. Construction site management interview
4. Site management evaluation and analysis

The variety of methodologies were adopted to reflect the different aspects of construction sites and to reflect overall project objectives.

The McDonald & Hrymak (2002) methodology used a quantitative and qualitative approach to measuring site safety performance. The quantitative work involved the design of an observational study. This resulted in an observational study checklist to evaluate safety and health performance levels with recommended health and safety requirements on construction sites.

For this research a similar site safety observation item checklist was developed to pay particular attention to the category falls from height in construction. A total of 20 construction sites were surveyed in the Dublin area all of which include apartment buildings. All of the sites surveyed were large or medium size construction developments. The sites were all visited within the period from November 2003 to October 2004. Each site survey lasted on average three hours. In total there was 60-site item observations made on each of the 20 sites, which amounted to a total of 1,200 site item observations.

Site background

The number of separate building units on the 20 different sites varied from 1-5 blocks to over 10 blocks on site. On 15 (75%) out of 20 sites there were between 1-5 blocks on site. On 1 (5%) site out of 20 sites there was between 6 and 10 blocks on site. On 4 (20%) out of 20 sites there were more than 10 blocks on site.

The number of employees working on site varied from less than 100 employees to over 200 employees. Of the 20 sites 14 (70%) were small sites with less than 100 employees. There were 5 (25%) medium size sites with between 101 and 200 employees working. There was 1 large site with over 200 employees.

The different stages of work on the 20 sites also varied. On 16 (80%) out of the 20 sites involved mixed stages of construction work on site. On 3 (15%) out of 20 sites construction work on site was at the external shell stage. On 1 (5%) out of 20 sites construction work on site was above ground stage.

Site selection

The construction sites selected for this research were selected randomly. Most of the construction site developments were observed while travelling through the city. The relevant construction companies were then contacted and permission was requested to visit those sites for the purpose of this research. Other construction companies were contacted by phone to establish if they were currently developing any apartment blocks in Dublin. By combining both site selection processes this research eventually succeeded in selecting and visiting 20-construction sites.

The methodology was piloted successfully on one construction site in Dublin.

3.2 Construction site safety observational checklist.

A site safety observational checklist was produced to include site safety situations and activities encountered under three categories.

1. Working at heights.
2. Housekeeping.
3. Personal Protective Equipment.

This checklist was used to measure of the level of safety performance on each construction site visited. The observational items were listed under eight (8) different headings.

1. Working at Height Category.

1 Scaffolding

The observational items that were measured under this category were:

1. Scaffolding sound footing
2. Base-plate & sole boards
3. Platforms properly supported
4. Scaffold braced properly
5. Scaffold tied properly
6. Ladder access provided
7. Platforms fully boarded
8. Handrail & midrail in place
9. Toe-boards in place
10. Platforms kept clean

11. Trap boards
12. Brick-guards in place
13. Trestles used properly
14. Platform loads within maximum safe working load

2 Ladder access to heights.

The observational items that were measured under this category were:

1. Proper ladders in use
2. Ladders in good condition
3. Ladders 1 meter above landing
4. Ladders properly secured
5. Ladders used safely
6. Stepladders used safely

3 Mobile scaffolds

The observational items that were measured under this category were:

1. Mobile Scaffold boards in place
2. Mobile Scaffold guardrails fitted
3. Mobile Scaffold toe boards fitted
4. Mobile Scaffold safe means of access
5. Mobile Scaffold ground firm & level
6. Mobile Scaffold tower tied if unattended
7. Mobile Scaffold wheels locked
8. Mobile Scaffold base height ratio 1-3
9. Mobile Scaffold clear of people & material when moved
10. Mobile Scaffold used safely

4 Roof work

The observational items that were measured under this category were:

1. Roof work warning notices of fragile roof
2. Roof work crawling boards in place
3. Roof work edge protection in place
4. Roof work guardrails in place
5. Roof work toe boards in place

6. Roof work anchorage points for safety harness
7. Roof work is safety harness being worn

5 Mobile Elevated work platforms

The observational items that were measured under this category were:

1. MEWPs used on level ground
2. MEWPs guards in position
3. MEWPs harness clipped on when aloft
4. MEWPs operators trained
5. MEWPs current certificates available

2. Housekeeping category.

6 Housekeeping

The observational items that were measured under this category were:

1. Scaffold base free of rubbish
2. Lifts free of rubbish
3. Materials stored neatly & safely
4. Access routes & stairways rubbish free

7 Workplace access

The observational items that were measured under this category were:

1. Work place access routes clear
2. Work place access route with safe footing
3. Work place access route width adequate
4. Work place access routes appropriate signage
5. Work place access floor edges, openings protected
6. Work place access openings and manholes protected

3. Personal protection equipment category.

8 Personal protection equipment

The observational items that were measured under this category were:

1. Workers wearing safety footwear
2. Workers wearing safety helmets
3. Workers ear protection being worn where appropriate
4. Workers eye protection worn where appropriate
5. Workers respirators or masks worn where appropriate
6. Workers protective gloves worn where appropriate
7. Workers fall arrest equipment worn where appropriate
8. Workers wearing Hi-Vis vests

The results of the site visits were recorded in percentage of non-compliance with recommended safety practice. All 60-site safety observational items were rated on a percentage scale of compliance with recommended site safety practice.

The procedure for the observational study carried out on each site visited was as follows: A generalised description of the site including the size of the site, the number of blocks on site, number of site personnel and the stage of construction were recorded. The description for the different stages of work on site included foundation and groundwork, above ground, external shell, internal works and mixed stages. The mixed stages description was used to describe work on site where two or more of the different stages of work were being undertaken on site. The site was then surveyed and all information was recorded on the site safety observational checklist. In recording the information four responses were possible and recorded in specified ways, namely, yes, no, not applicable and the percentage non-compliance.

Work carried out safely, i.e. in complete compliance with recommended safety practice was recorded as 0% non-compliance. Unsafe conditions were recorded as a percentage of items on site non-compliant, e.g 40% non-compliance.

For example when 30 out of 100 site workers were found not wearing hard hats, this was recorded as 30% non-compliance. Similarly the amount of scaffold guardrails found to be missing was expressed as a percentage of the total. Hence where 100 meters of scaffolding was in use and 10 meters of the scaffolding was without adequate guarding, it was recorded as 10% non-compliance. Another example would be when a quarter of all materials on site were found stacked or stored unsafely (i.e. capable of toppling over and causing injury) it was recorded as 25% non-compliance.

If an item in the checklist was not found on site it was recorded as (N/A) not applicable, not seen.

All safety items on the site safety observational checklist were completed for all the 20 sites surveyed.

The results of the research findings for the construction site observational checklist (1-60) are presented for each different heading as a percentage of non-compliance. In addition the percentages of non-compliance are grouped under 5 descriptions in the graph/table, namely complete compliance, low, med, high and very high non-compliance.

Complete compliance = 0% representing 0% non-compliance. This is complete safety compliance.

Low = 0-4%	representing 0% to 4% non-compliance with recommended safety practices.
Medium = 5-9%	representing 5-9% non- compliance with recommended practice.
High = 10-20%	representing 10-20% non- compliance with recommended practice.
Very high = 20%>	representing 20% or higher non- compliance with recommended practice.

The construction site safety observational checklist study is included in appendix A.

The explanation of checklist item numbers & recommended practice is included in Appendix F.

Fall from Height variables

In order to measure specific areas of safety performance certain (variables) were aggregated. See table 36 below for fall from height variables 1-11.

Table 36, Description of fall from height variables

Handrail & midrail in place
Ladders properly secured
Ladders used safely
Mobile Scaffold guardrails fitted
Work place Access floor edges, openings protected
Work place access manholes access openings protected
Roof work edge protection in place
Roof work guardrails in place
Roof work safety harness
MEWPs Mobile elevated work platforms guards in position
MEWPs Mobile elevated work platforms harness clipped on when aloft

Housekeeping variables V 1-7

In order to measure specific areas of safety performance certain variables were aggregated. See table 37 below for housekeeping variables 1-7.

Table 37 Description of housekeeping variables

Scaffold platforms kept clean
Workplace access, clear access routes
Workplace access, safe footing
Scaffold base free of rubbish
Scaffold lifts free of rubbish
Materials stored neatly and safely
All access routes and stairways rubbish free

3.3 Construction site documentation checklist and analysis.

Site safety documentation was inspected and analysed on all 20 sites visited. The assessment covered eleven different site safety documents. This assessment consisted of verifying the availability and standard of documentation. The site safety documentation was inspected using the following assessment criteria.

Table 38 Construction site safety documentation checklist and analysis

No	Document description	Available		Standard			Access	
		Yes	No	Low	Med	High	Yes	No
1	Project Supervisor Construction Stage Safety Plan							
2	All safety statements Main Contractor & Sub contractors							
3	Method statements							
4	Risk assessments site specific							
5	Safety Audits							
6	Safety meetings							
7	Safety induction records							
8	Training employees Certificates & records							
9	Certs. for equipment & machine tests forms CR1-9							
10	(IR1) Accident & (IR3) Dangerous occurrence report forms to the HSA							
11	Accident log book							

Standard of documentation.	
Low	Documentation generic and not site specific.
Medium	Documentation not generic fair standard.
High	Documentation site specific, well thought out with a lot of effort and revised regularly.
Comments	

The site documentation checklist is included in Appendix B.

3.4 Construction site Management Interviews.

A total of 45 semi-structured interviews were conducted across 20 sites with a range of managers and personnel responsible for safety. The sample included Project Managers, Safety Officers, Engineers, Foremen, Safety Representatives and Quantity Surveyors.

At the beginning of each site visit relevant site personnel were contacted and asked if they were willing to take part in the interview. Each interviewee was briefed on the background to the research and the research objectives.

Each of the areas of work explored also had a corresponding quantitative measure that was completed at the end of each interview. The interviews lasted between 20 minutes and 1 hour. Most management personnel interviews were conducted on site however due to site commitments and time constraints it was not possible for some management personnel to give interviews on site. As a result some interviews had to be conducted by phone at a later time that was suitable to the interviewee. The interviews were all recorded in writing and interviews were also audio recorded with the prior consent of the interviewee. The completed written interview was then checked against the audio recording to ensure the accuracy and detail of the interview. The questions included,

- Background information of interviewee's.
- Plan of action for dealing with safety related issues.
- Competence of workforce and ongoing training in safety.
- Monitoring system.
- Reporting system.
- Communication in the workplace.
- Responsibility for safety in the workplace.
- Co-operation between the main contractor and sub-contractors.
- Personal suggestions to improve safety.

The Interview template is included in Appendix C.
The site Management template is included in Appendix D.

3.5 Limitations.

There are a number of limitations in this methodology. Referring to interviews there is the possibility of bias of interviewees, views, answers to questions and suggestions, e.g. pro management bias or anti management bias. There is also the possibility of transcription errors.

Observations.

The sites visited during this research represented large or medium sized construction sites and did not represent small construction sites. The results therefore will not be a true representation or reflection of the safety conditions on construction sites in general as previous research found that larger construction sites had higher levels of safety compliance when compared to smaller sites, (H.S.A. 2002).

Site management had prior knowledge of visits to their sites and on some sites management may have made site personnel aware of visits and as a result site personnel may have been more compliant with safety matters e.g. wearing PPE etc. Also site management may have taken remedial action to improve safety on site prior to visits.

All sites were visited on only one occasion and this may not represent a true picture of the overall level of safety during the entire life of the construction project. A number of site visits to each site over the life of the construction project would give a more accurate result to the general overall safety levels on site.

Each construction site visited had a construction site observational checklist of sixty items. For the 20 sites visited this represented 1,200 items. It must be cautioned that all items may not have been observed correctly.

Mobile scaffolds were observed in use on only 2 sites. This sample is too small from which to draw significance or conclusions from the research results.

Sample size.

The research sample surveyed in this research represented over 40% of the apartment completions for Dublin in 2004. According to the Department of the Environment housing statistics there was 16,810 residential units completed in Dublin in 2004, 6,995 of the completions were apartments or 42% of the entire residential completions. The number of apartments being constructed on the 20 sites viewed in this survey was over 2,800 apartments or over 40% of the entire apartment completions for Dublin in 2004. The first site was visited in November 2003 while the remaining 19 sites were visited in 2004. Even though the majority of construction sites visited was in 2004 most of the construction on these sites was not completed until 2005.

In 2005 in Dublin 18,019 residential units were complete of which 9,542 were apartments or 53% of the entire residential completions. In 2005 a total of 18,035 apartments were completed for the entire country. The number of apartments completed in Dublin in 2005 (9,542) represented nearly 53% of the entire apartments completed in the entire country. Therefore the sample is representative of the apartment building construction sector in Dublin.

4 Results

4.0 Results

4.1 Overall summary of results.

The following graph shows the overall mean percentage level of non-compliance for the 3 categories of falls from height, housekeeping and personal protective equipment for sites 1-20.

Figure 2

Overall mean percentage level of non- compliance across the 20 sites.

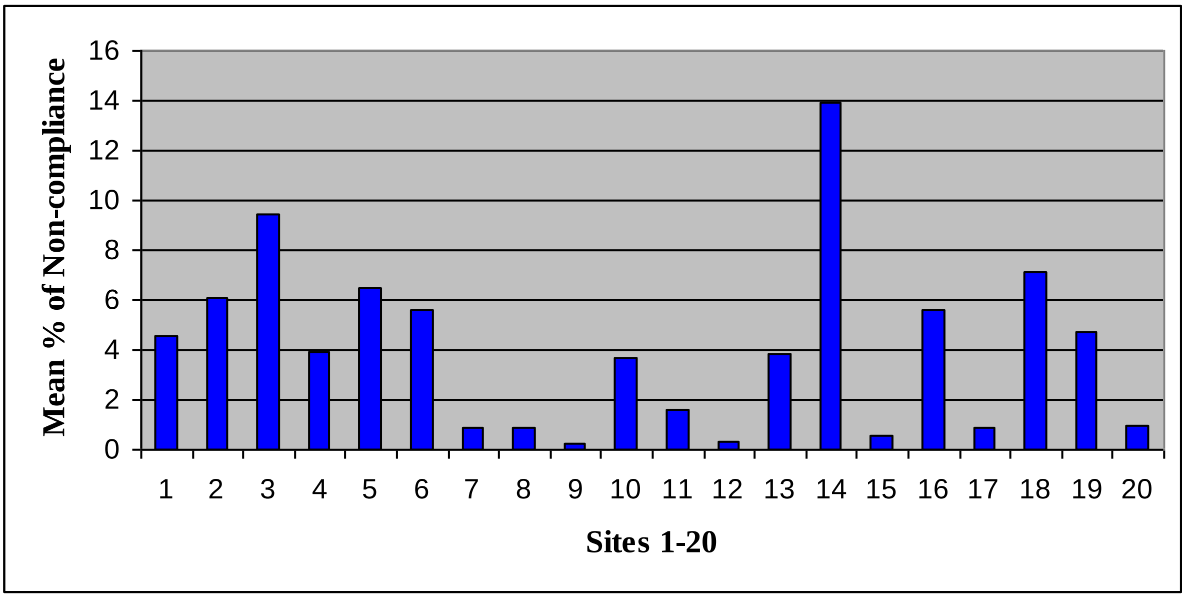


Table 39

Overall average mean percentage level of non-compliance for the 3 categories falls from height, housekeeping and PPE for all 20 sites.

No of sites	Level of non-compliance
0	Complete compliance
13	Low
6	Medium
1	High

The overall level of safety compliance across the 20 sites was variable. Compliance ranged from low level of non-compliance to a high level of non-compliance. No site achieved full safety compliance. Thirteen sites out of twenty (65%) achieved a low level of safety non-compliance for all site observational variables. Six sites out of twenty (30%) achieved a medium level of safety non-compliance of between 5-9% non-compliance. One site out of twenty (5%) achieved a high level of safety non-compliance of between 10-20% of non-compliance.

4.2 Summary of "Fall from Height Prevention".

The graph shows the mean percentage level of non-compliance for falls from height prevention for the sites 1-20.

Figure 3

Overall mean percentage level of non-compliance for fall from height prevention

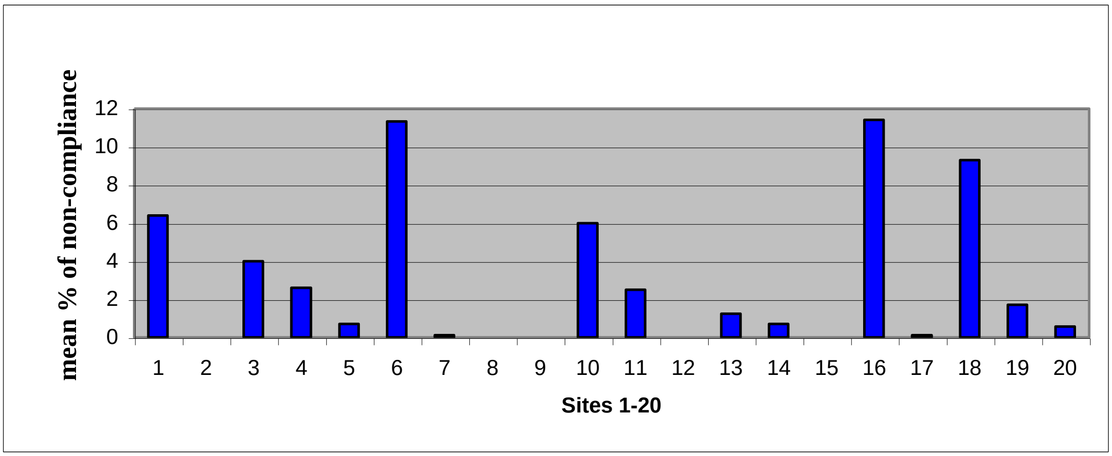


Figure 3: shows the mean percentage level of non-compliance for falls from height prevention for sites 1-20

Table 40

Summary of the mean percentage level of non-compliance for fall from height prevention variables for sites 1-20

No of sites	Level of non-compliance
5	Complete compliance
10	Low
3	Medium
2	High

The level of falls from height safety compliance across the 20 sites visited was variable. Compliance ranged from complete compliance to a high level on non-compliance. Five sites out of twenty (25%) had complete compliance across the eleven different falls from height variables. Ten out of the twenty sites (50%) had a low level of non-compliance for falls from height variables. Three out of the twenty sites (15%) had a medium percentage of non-compliance. Two sites out of twenty (10%) of sites had a high level of non-compliance.

The areas of poor safety compliance for falls from heights.

The worst area of non-compliance in relation to falls from heights was floor edges and openings not being protected. Here nine sites out of twenty (45%) did not protect employees from falls. Three sites out of twenty (15%) had a high level of non-compliance of between 10-20%.

Major non-compliance in relation to fall from height protection was also found where ladders were not properly secured on five out of twenty sites (25%) of sites.

Major non-compliance was also found where roof work edge protection was missing on four out of sixteen (25%) sites with a very high level of non-compliance on one site with non-compliance over 20%.

Major non-compliance was also found where scaffolding handrails and midrails were missing on four (20%) out the twenty sites did not have adequate protection to prevent falls from heights.

Non-compliance was also found in the non-wearing of safety harnesses. On three (36.75%) out of eight sites there was a high level of non-compliance in relation to the wearing of roof work safety harnesses where non-compliance was between 10- 20% non-compliance.

4.2.1 Scaffolding

Figures 4-18 show various working at height and housekeeping items. All these charts show variable results.

Figure 4

Scaffolding overall mean percentage level of non-compliance for sites 1-20

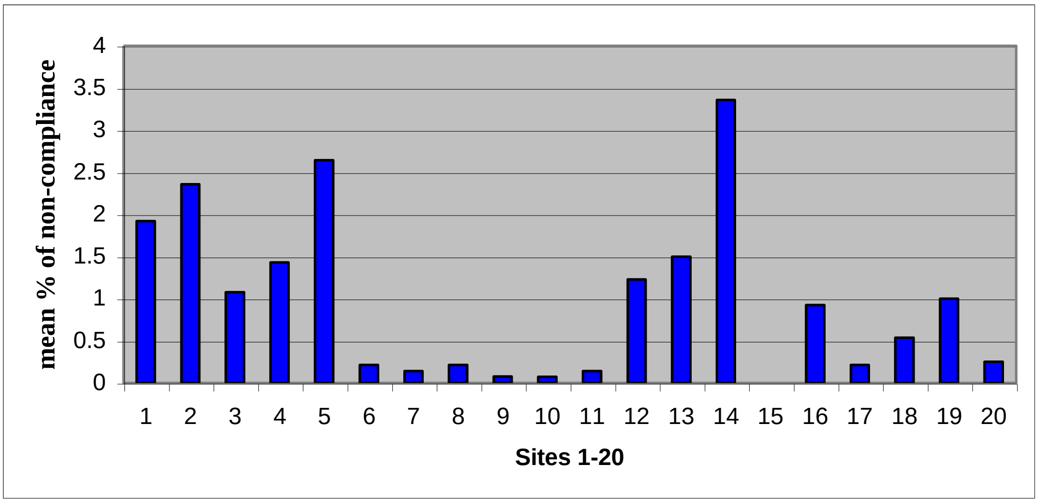


Figure 4: Scaffolding overall mean percentage level of non-compliance for variables (1-14) on sites 1-20.

Figure 5

Scaffolding, handrail and midrail mean percentage level of non-compliance on sites 1-20.

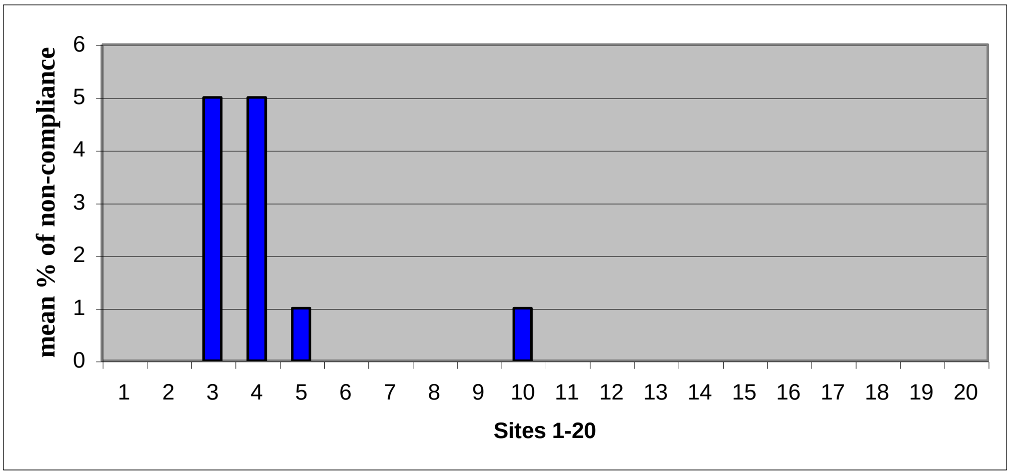


Figure 5: Scaffolding handrail and midrail mean percentage level of non-compliance on sites 1-20.

Figure 6

Scaffolding toe board mean percentage level of non-compliance on sites 1-20.

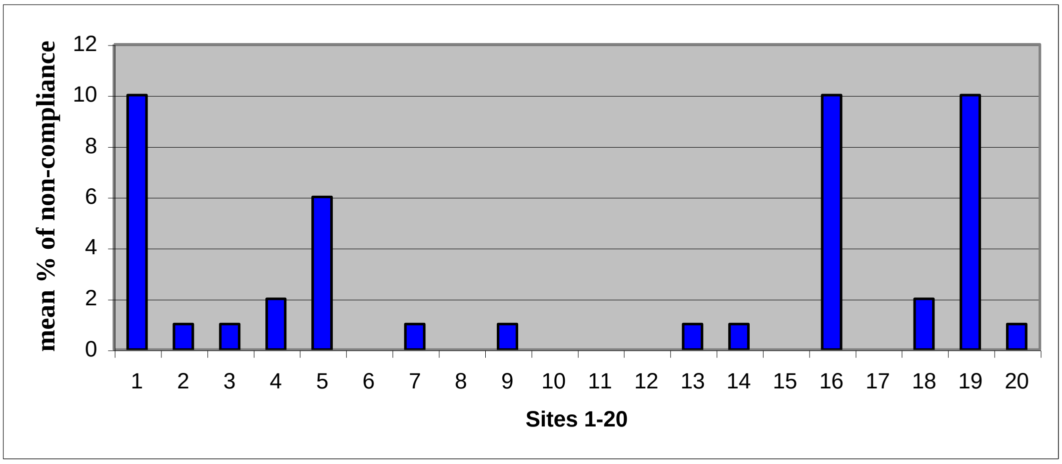


Figure 6: Scaffolding toe board mean percentage level of non-compliance on sites 1-20.

4.2.2 Ladder access to Heights

Figure 7

Ladder access to heights overall mean percentage level of non-compliance, variables 1-6 for sites 1-20

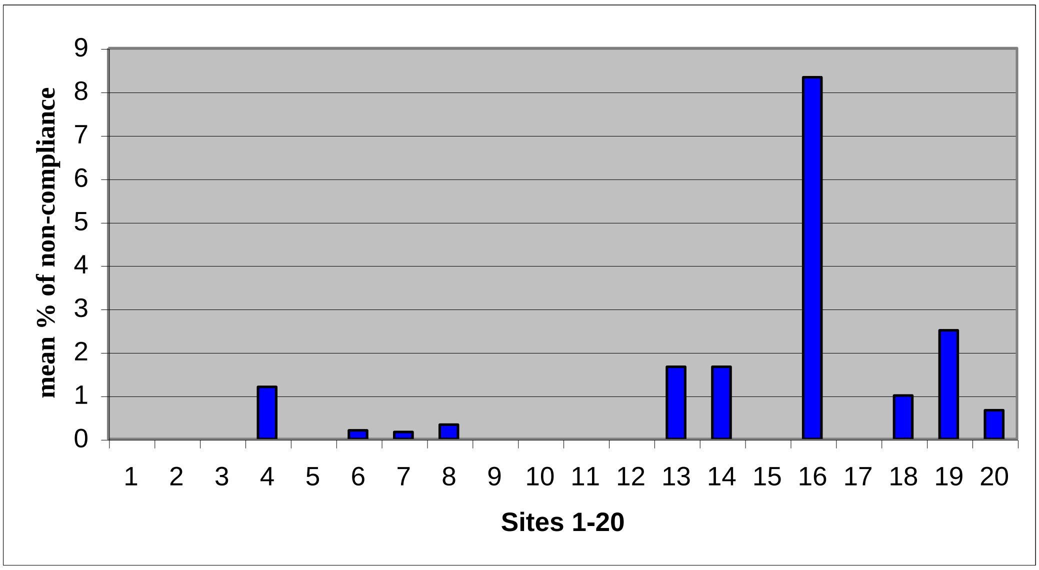


Figure 7: Ladder access to heights mean percentage level of non-compliance.

Figure 8

Proper ladders in use mean percentage level of non-compliance for sites 1-20

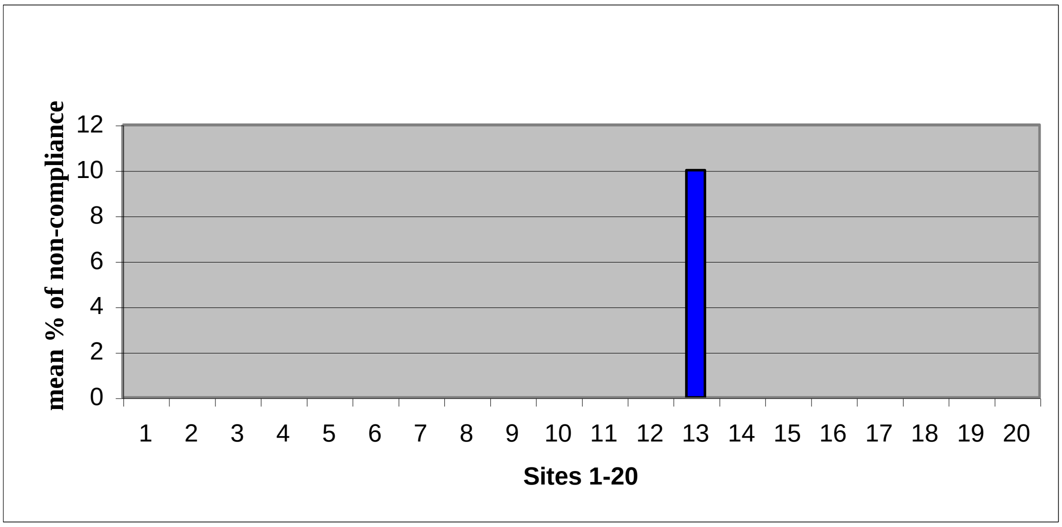


Figure 8: Proper ladders in use mean percentage level of non-compliance for sites 1-20

Figure 9

Ladders used safely mean percentage level of non-compliance for sites 1-20

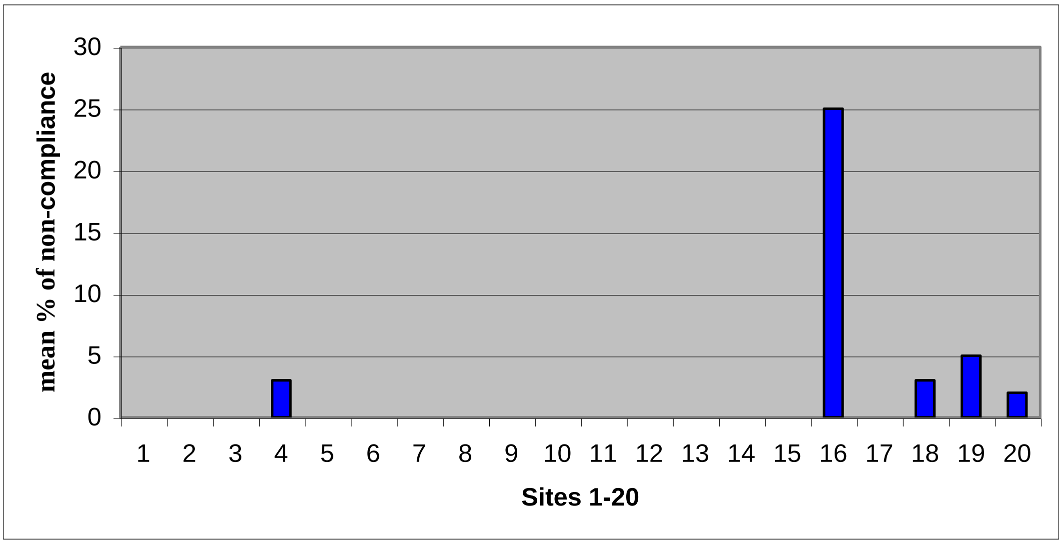


Figure 9: Ladders used safely mean percentage level of non-compliance for sites 1-20

Figure 10

Ladder positioned properly and extended 1 meter above landing mean percentage level of non-compliance for sites 1-20.

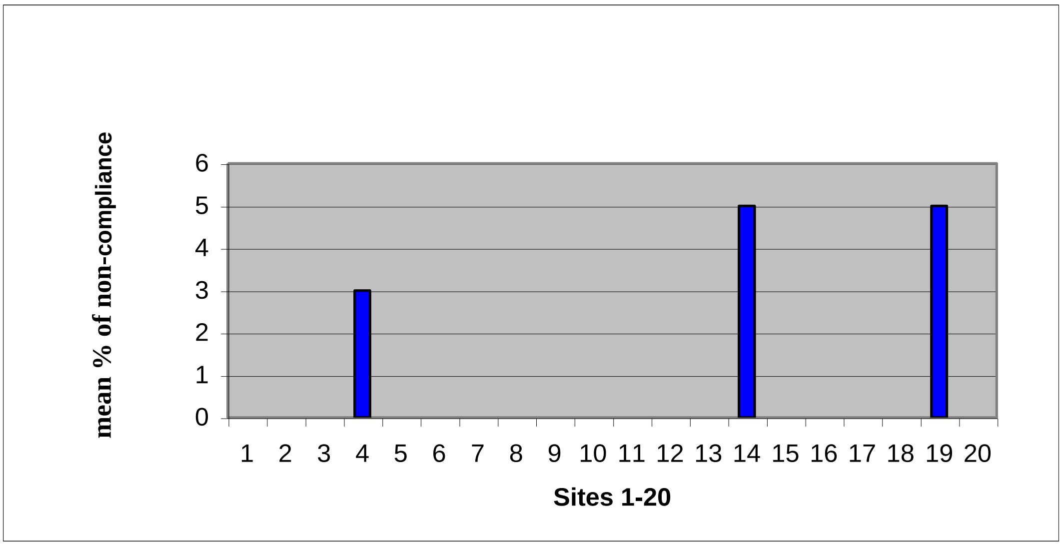


Figure 10: Ladder positioned properly and extended 1 meter above landing mean percentage level of non-compliance for sites 1-20

Figure 11

Ladders secured properly mean percentage level of non-compliance for sites 1-20

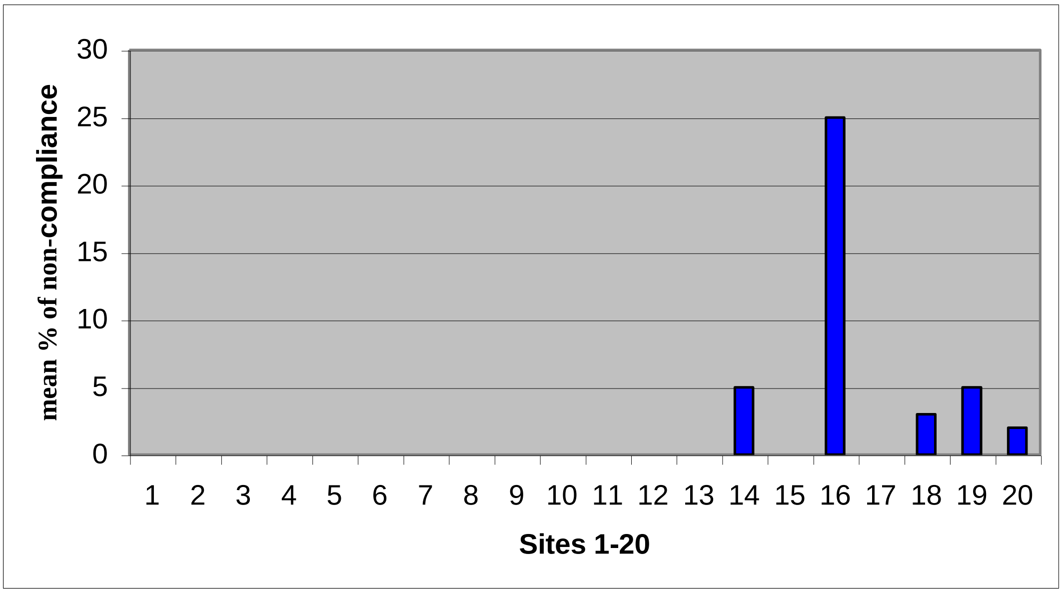


Figure 11: Ladders secured properly mean percentage level of non-compliance for sites 1-20.

4.2.3 Roof Work

Figure 12

Roof work safety overall mean percentage level of non-compliance, variables (1-7) for 16 of the 20 sites.

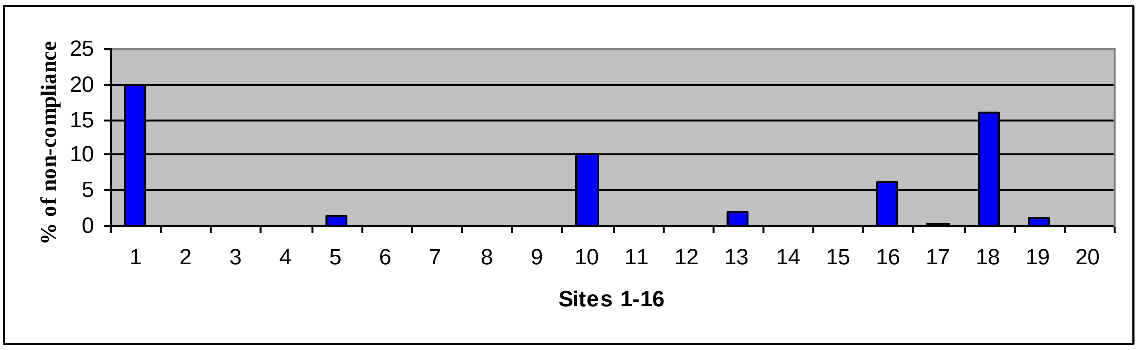


Figure 12: Roof work safety over mean percentage of non-compliance, variables (1-7) for 16 of the 20 sites

Figure 13

Roof work edge protection mean percentage level of non-compliance for 16 of the 20 sites

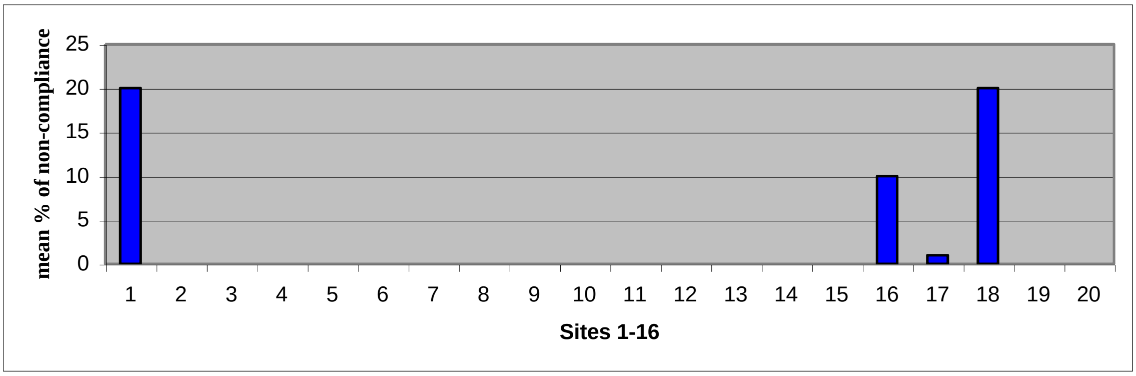


Figure 13: Roof work edge protection mean percentage level of non-compliance for 16 of the 20 sites.

Figure 14

Roof work guardrails mean percentage level of non-compliance for 16 of the 20 sites.

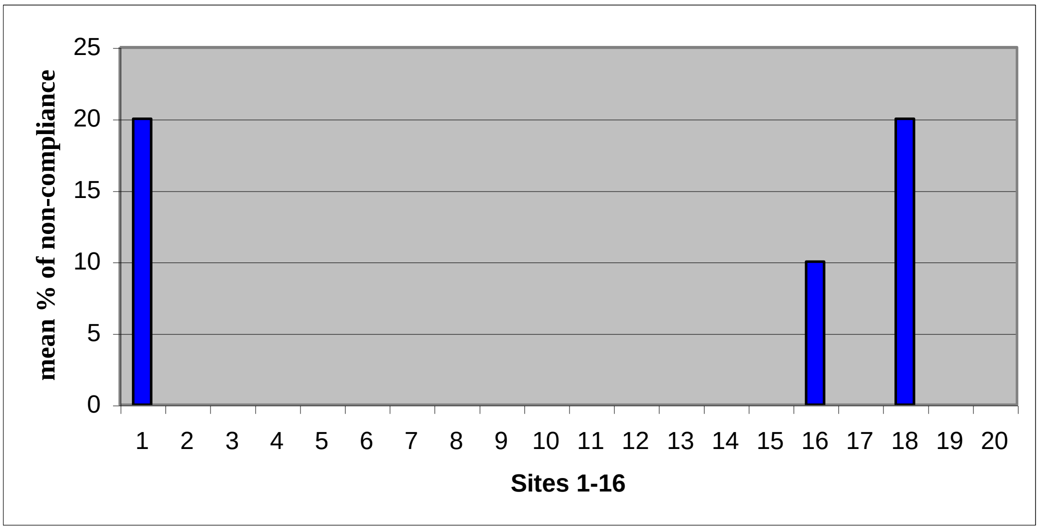


Figure 14: Roof work guardrails mean percentage level of non-compliance for 16 of the 20 sites.

Figure 15

Roof work safety harness being clipped on when aloft mean percentage level of non-compliance for 8 of the 20 sites.

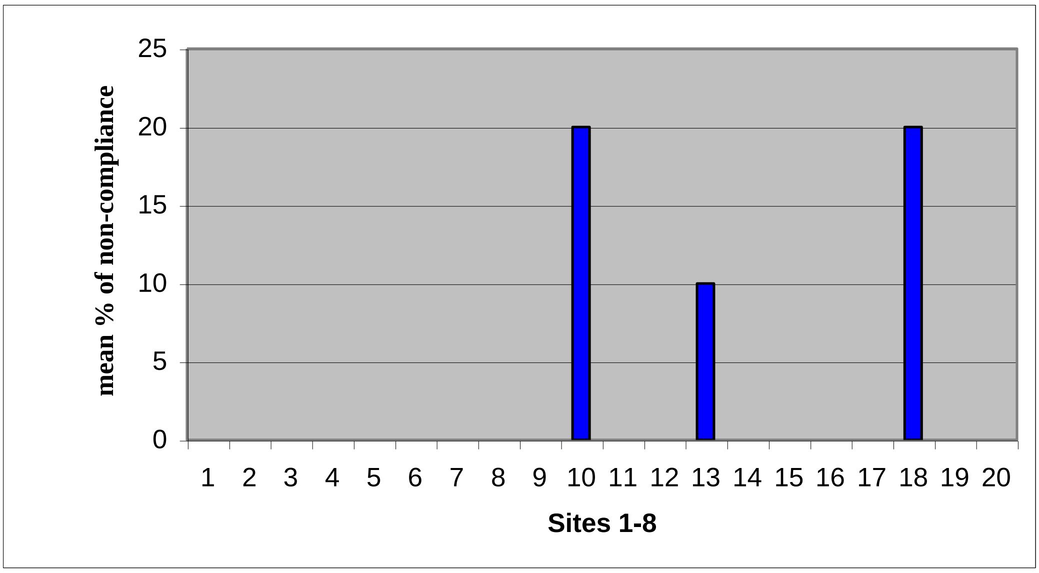


Figure 15: Roof work safety harness being clipped on when aloft mean percentage level of non-compliance for 8 of the 20 sites.

4.2.4 Mobile Elevated Work Platform

Figure 16

MEWPs harness being clipped on when aloft mean percentage level of non-compliance for 4 out of 20 sites where MEWPs were being used.

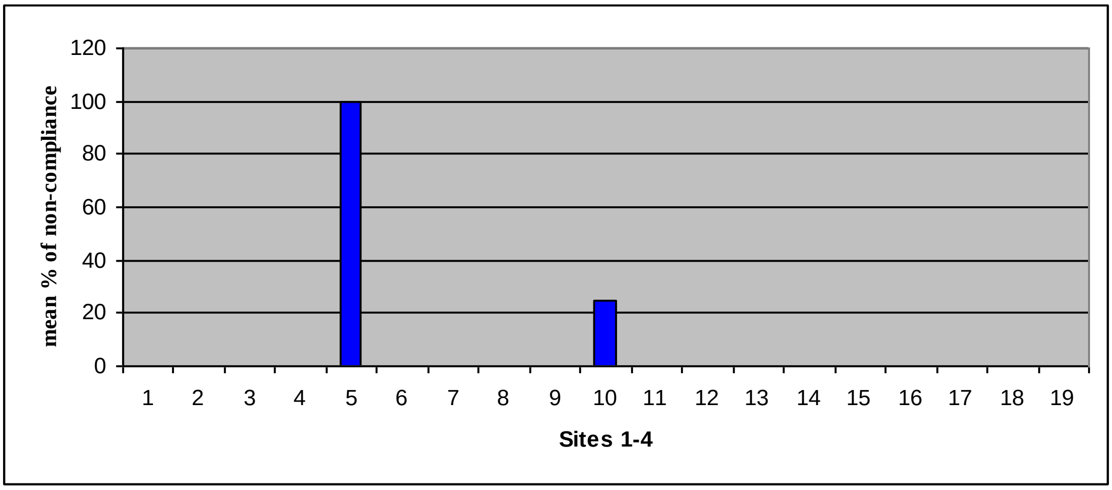


Figure 16: MEWPs harness being clipped on when aloft mean percentage level of non-compliance for 4 of the 20 sites.

4.2.5 Workplace access

Figure 17

Workplace access floor edges & openings protected mean percentage level of non-compliance for sites 1-20

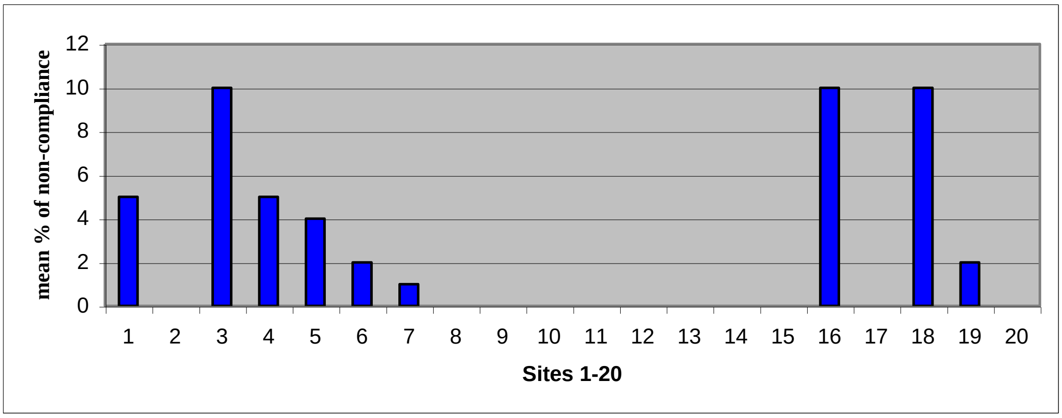


Figure 32: Workplace access floor edges & openings protected mean percentage level of non-compliance for sites 1- 20

4.3 Housekeeping safety compliance summary

Figure 8 shows the mean percentage of non-compliance for safety compliance for housekeeping for sites 1-20.

Figure 18

Housekeeping overall mean percentage level of non-compliance for sites 1-20

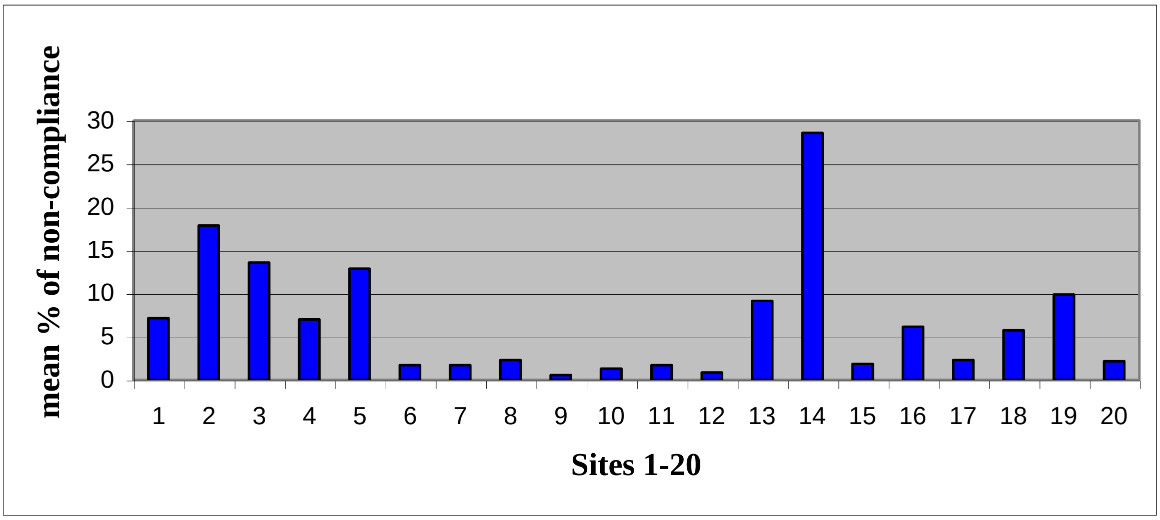


Figure 18: Housekeeping mean percentage level of non-compliance for housekeeping for sites 1-20

Table 41

Summary of housekeeping mean percentage level of non-compliance for sites 1-20

No of sites	**Level of non-compliance**
0	Complete compliance
10	Low
6	Medium
3	High
1	Very high

In relative terms housekeeping was the least compliant area for safety compliance. The level of housekeeping for all the housekeeping variables was variable ranging from low to a very high level of non-compliance None of the twenty sites were fully compliant. Only ten (50%) out of twenty sites had a low level of non- compliance. Six (30%) out of twenty sites had a medium level of non-compliance of 5%-9% non-compliance. Three (15%) out of twenty sites had a high level of housekeeping non-compliance of between 10-20% non-compliance. One (5%) site out of 20 had a very high level of housekeeping non-compliance of over 20% or higher non-compliance.

The areas of poor safety compliance for housekeeping.

The worst area of housekeeping non-compliance was in relation to scaffold bases not being free of rubbish where ten (50%) out of twenty sites had a medium level of non-compliance of 5% or higher non-compliance. Five (25%) sites out of 20 had a very high level of housekeeping non-compliance of 20% or higher two of which had 60% non-compliance.

The next highest area of non-compliance was found where housekeeping materials were not stored neatly and safely. Ten (50%) sites out of 20 had 5% or higher non-compliance with six (30%) out of 20 sites with a high level non-compliance of 10% or higher.

The next highest area of non-compliance was found where lifts were not free of rubbish. Eight (40%) out of twenty sites had medium non-compliance rates of 5% or higher

The next highest area of non-compliance was in relation to scaffold platforms being kept clean. Here seven (35%) sites out of twenty had medium non-compliance of 5% or higher. Two (10%) sites out of twenty had a very high level on non-compliance of 20% or higher.

The next highest area of non-compliance was found where housekeeping access routes and stairways were not rubbish free. Four (20%) out of twenty sites had a high level of safety non-compliance of between 10-20% n/c.

It can be concluded that housekeeping had a high level of non-compliance. There is much improvement needed on the majority of the sites visited to raise the level of housekeeping compliance. A sizeable number of sites were particularly high or very high level of housekeeping non-compliance. On the sites visited housekeeping was not a safety priority.

4.3.1 Housekeeping.

Figure 19

Housekeeping scaffold base free of rubbish mean percentage level of non-compliance for sites 1- 20

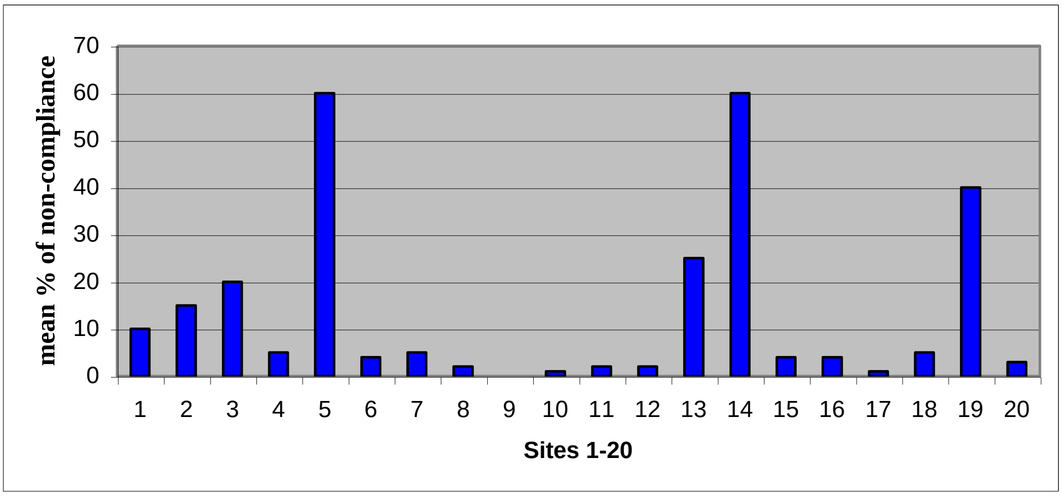


Figure 19: Housekeeping scaffold base free of rubbish mean percentage level of non-compliance for sites 1- 20

Figure 20

Housekeeping, materials stored neatly and safely mean percentage level of non-compliance for sites 1- 20

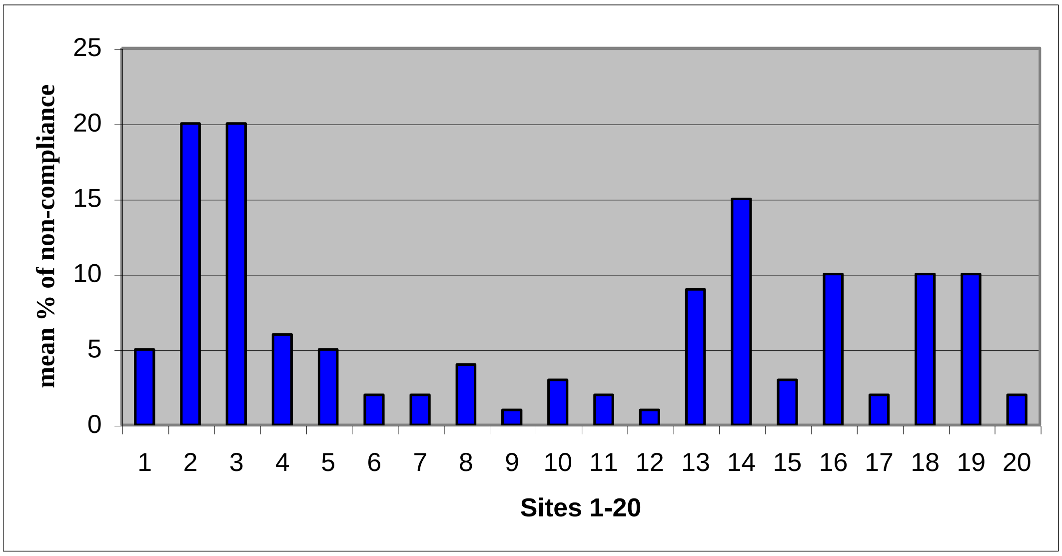


Figure 20: Housekeeping, materials stored neatly mean percentage level of non-compliance for sites 1- 20

Figure 21

Housekeeping, scaffold lifts rubbish free mean percentage level of non-compliance for sites 1- 20

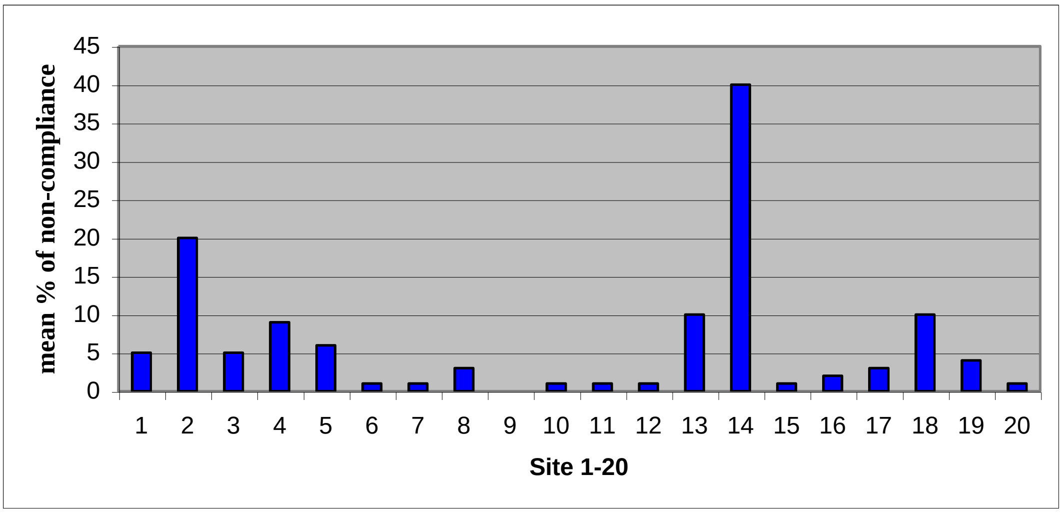


Figure 21: Housekeeping, scaffold lifts rubbish mean percentage level of non-compliance for sites 1- 20

Figure 22

Housekeeping all access routes & stairways rubbish free mean percentage level of non-compliance for sites 1- 20

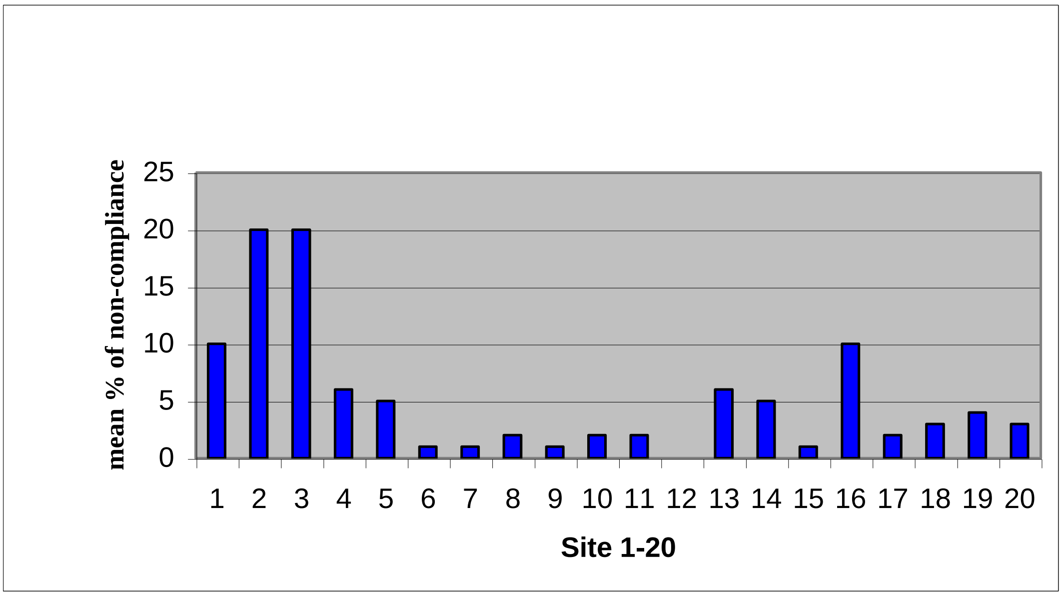


Figure 22: Housekeeping all access routes & stairways rubbish free mean percentage level of non-compliance for sites 1- 20

4.3.2 Workplace access

Figure 23

Workplace access overall mean percentage level of non-compliance for sites 1-20

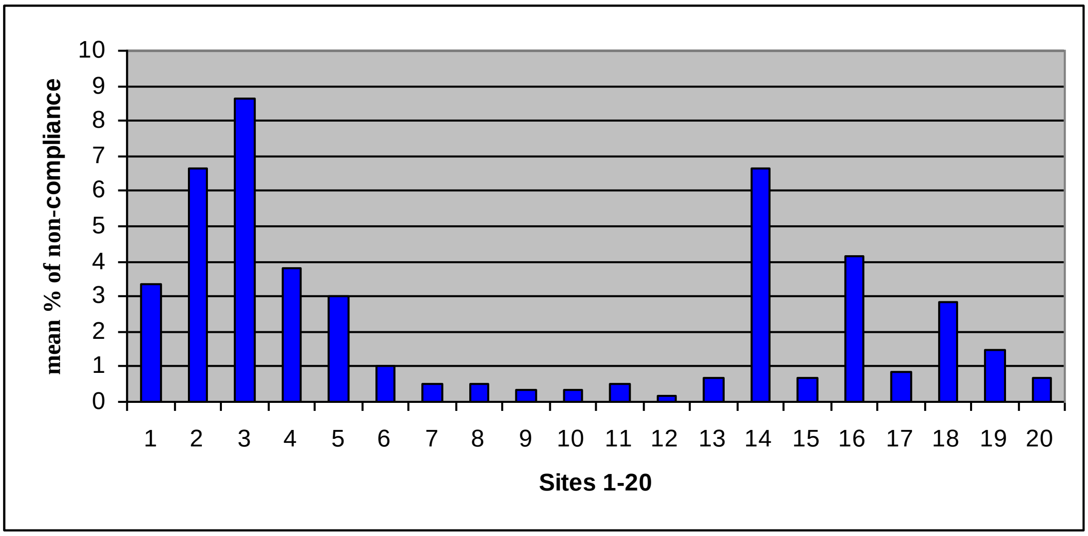


Figure 23: Workplace access mean percentage of non-compliance for variables (1-6) for sites 1-20

Figure 24

Workplace access routes clear mean percentage level of non-compliance for sites 1-20

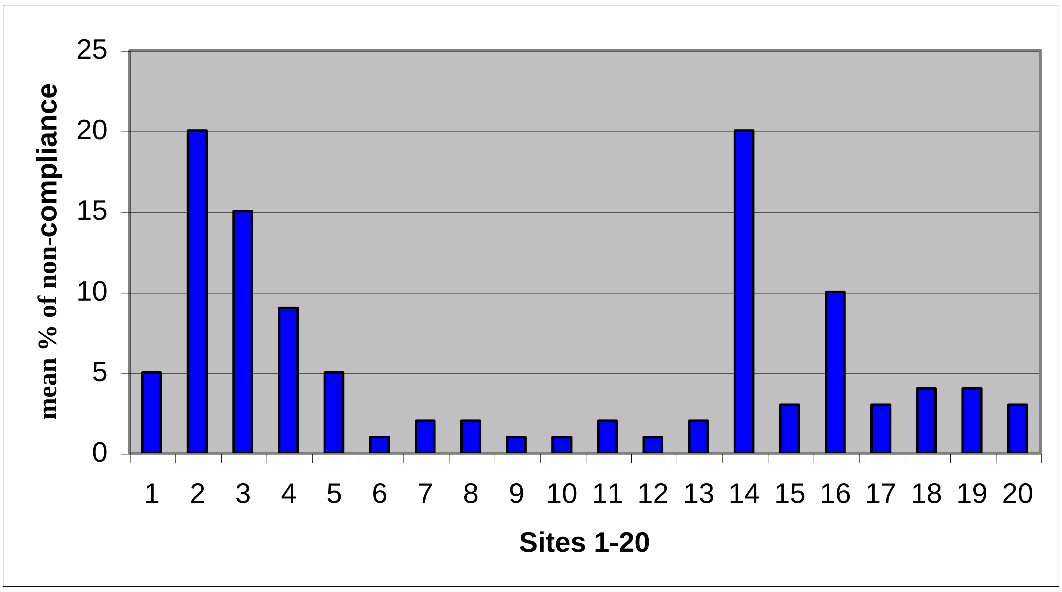


Figure 24: Work place access routes clear mean percentage level of non-compliance for sites 1-20

Figure 25

Workplace access routes with safe footing mean percentage level of non-compliance for sites 1-20

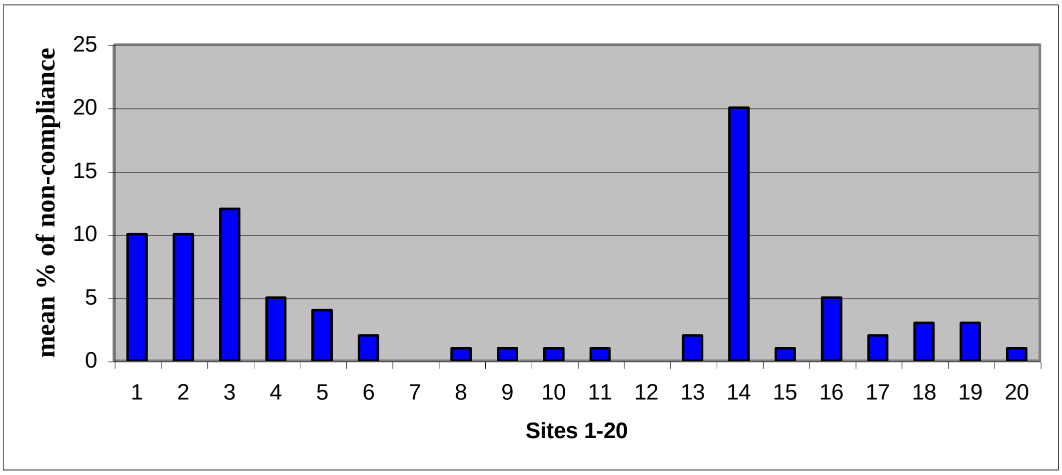


Figure 25: Workplace access routes with safe footing mean percentage level of non-compliance for sites 1- 20.

4.4 Personal Protective Equipment summary

Figure 26

Personal Protective Equipment overall mean percentage level of non-compliance for sites 1-20

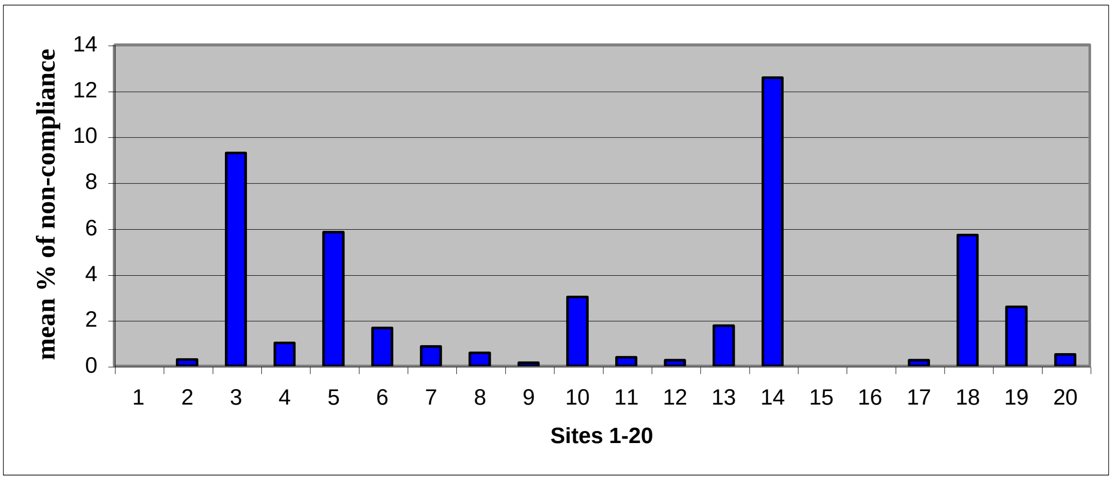


Figure 26: P.P.E mean percentage level of non-compliance for variables (1-8) for sites 1-20

Table 42

Summary of mean percentage level of non-compliance for personal protective equipment variables for sites 1-20

No of sites	Level of non-compliance
3	Complete compliance
13	Low
3	Medium
1	High

The overall level of safety compliance in relation to Personal Protective Equipment was generally low for five out of the eight PPE variables. For three of the eight PPE variables there was a high level of non-compliance. Only three (15%) out of twenty sites had complete safety compliance or 0% non-compliance for all eight PPE variables. Thirteen (65%) out of twenty sites had a low level of non-compliance of between 1-4% n/c. Three (15%) out of twenty sites had a medium level of non-compliance of between 5-9% n/c. One (5%) out of twenty sites had a very high level of non-compliance of over 20% n/c.

The worst area of non-compliance in relation to PPE was where employees were not wearing safety helmets. Fourteen (70%) out of twenty sites were not fully compliant in relation to the wearing of safety helmets. Two (10%) out of twenty sites had a very high level on non-compliance of over 20% with one site as high as 68% non-compliance.

The next highest area of non-compliance was the non-wearing of Hi Viz vests. Seven (35%) out of twenty sites were non-compliant. Three (15%) out of twenty sites had a high level of non-compliance of between 10-20% non- compliance.

The next highest area of non-compliance was the non-wearing of fall arrest equipment where appropriate. Of the fourteen sites where the wearing of fall arrest equipment was appropriate four (28%) sites out of fourteen were non-compliant. Three of the four sites had a high level of non- compliance of between 10-20% of non-compliance. One site had a very high level of non-compliance of 50%.

It can be concluded that there was an overall low level of non-compliance for the wearing of PPE. However there is a need for improvement on a large number of sites in relation to the wearing of safety helmets, Hi Viz vests and fall arrest equipment. On these sites the levels of safety influence, controls and supervision were not strong enough to ensure that all employees were fully compliant in relation to the wearing of personal protective equipment.

4.4.1 Personal Protective Equipment

Figure 27

Personal Protective Equipment, all wearing safety helmets mean percentage level of non-compliance for sites 1-20

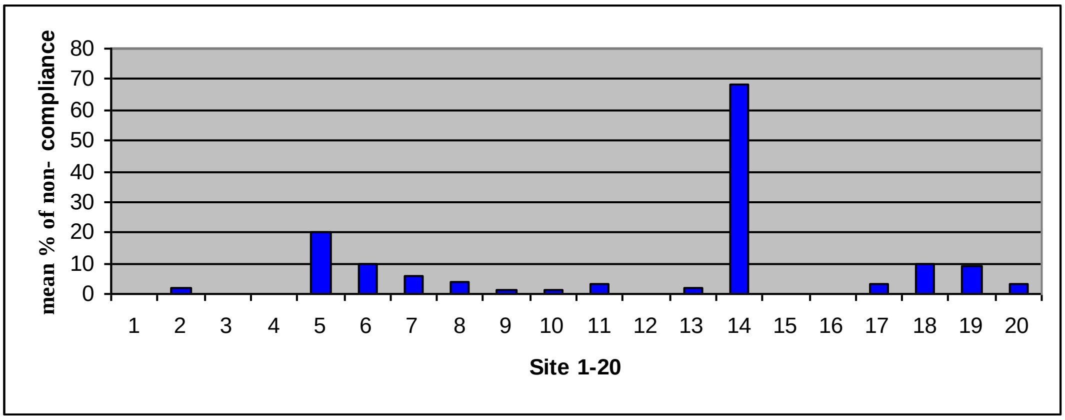


Figure 27: PPE, all wearing safety helmets mean percentage level of non-compliance for sites 1- 20

Figure 28

PPE, fall arrest equipment being worn where appropriate mean percentage level of non-compliance for sites 1-20

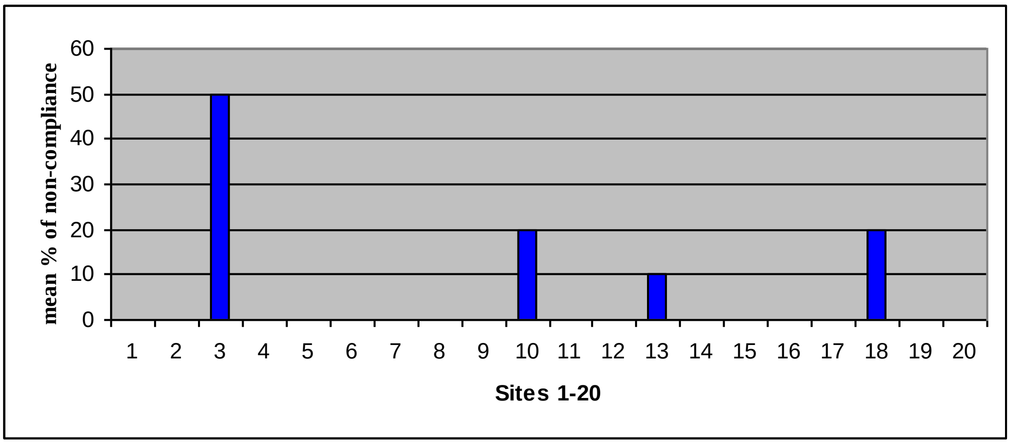


Figure 28: PPE, fall arrest equipment being worn where appropriate mean percentage level of non-compliance for sites 1- 20

Figure 29

PPE, all wearing Hi-Viz vests mean percentage level of non-compliance for sites 1-20

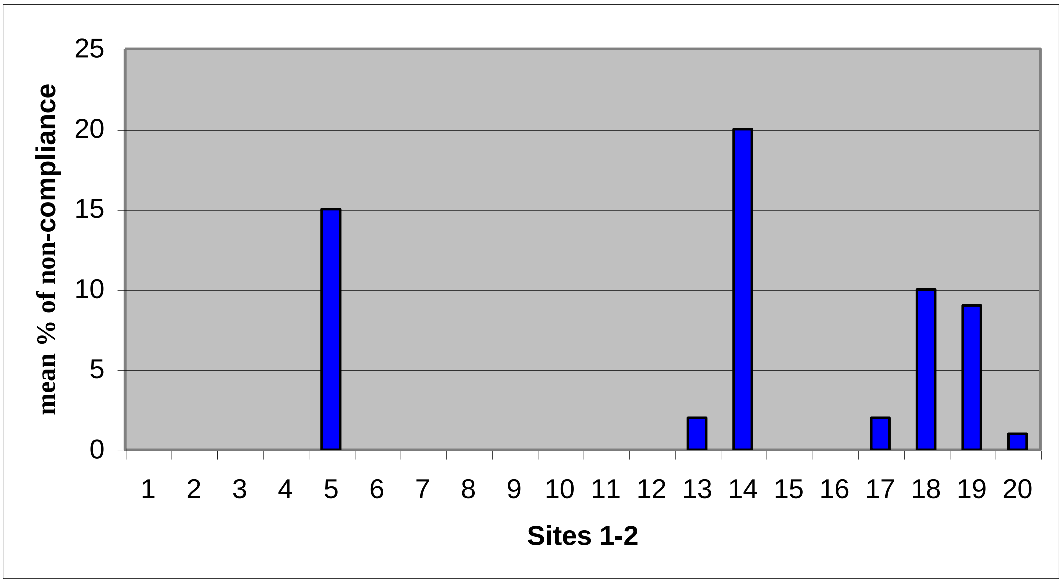


Figure 29: PPE, all wearing Hi-Viz vests mean percentage level of non-compliance for sites 1- 20

4.5 Site Documentation

Table 43

Site Documentation

No	Document description	Available		Standard			Access	
		Yes	No	Low	Med	High	Yes	No
1	Project Supervisor Construction Stage Safety Plan	20			1	19	20	
2	All safety statements Main Contractor & Sub contractors	20				20	20	
3	Method statements	20				20	20	
4	Risk assessments site specific	20				20	20	
5	Safety Audits	20			1	19	20	
6	Safety meetings	15	5		3	12	15	5
7	Safety induction records	20				20	20	
8	Training employees Certificates & records	20				20	20	
9	Certificates for equipment & machine tests forms CR1-9	20				20	20	
10	(IR1) Accident & (IR3) Dangerous occurrence report forms to the HSA	18	2			18	18	
11	Accident log book	20				20	20	

Table 43: This table shows that for site documentation under the 11 different headings for all 20 sites compliance was high in nearly all 20 sites in relation to standard, availability and access.

4.6 Site Management Summary

The number of interviewee's interviewed was forty five.

Overall site safety management as perceived by the interviewees was assessed using the following eleven items using a low, medium and high scale. These eleven items were,

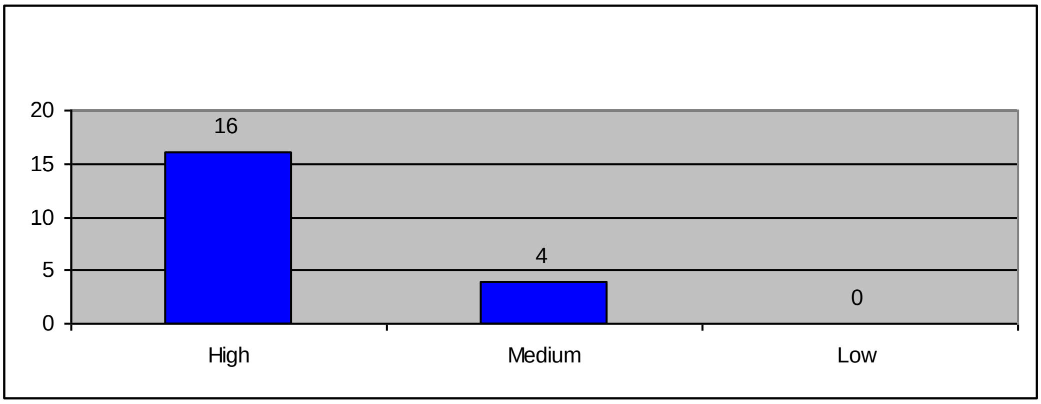
- Concrete plan of action to handle safety?
- The company is concerned about operatives, subcontractors' training /competence at the recruitment stage?
- The company is concerned about managers/supervisors' competence at the time of recruitment?
- The company provides ongoing training to operatives?
- The company provides ongoing training for managers & supervisors?
- Frequency of audits carried out in the company?
- Effectiveness of audits to redirect organisational action?
- H.S.A. Inspections?
- The quality of communication about safety in the workplace?
- The assumption of responsibility by the main contractor for all safety in the workplace?
- Co-operation between the main contractor and sub-contractors?

4.6.1 Site Management

On all 20 sites there was a concrete plan of action to handle safety. Also the assumption of responsibility by the main contractor for all safety in the workplace was high on all 20 sites.

Figure 30

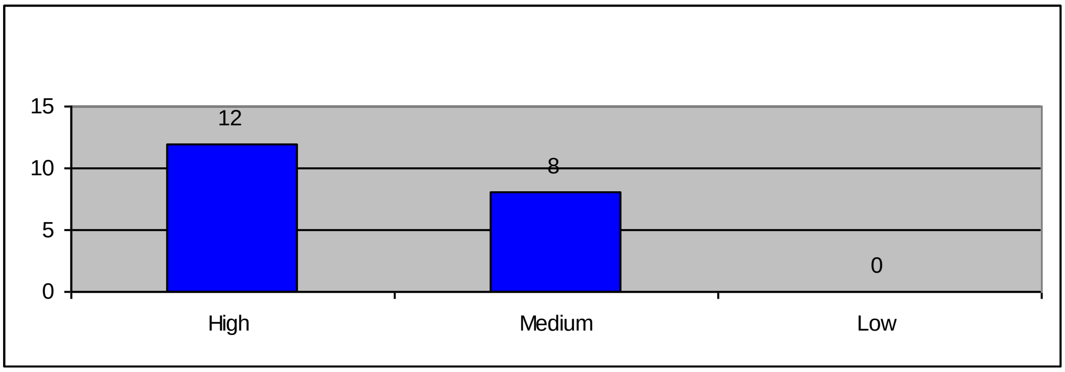
The company is concerned about operatives, subcontractors' competence at the recruitment stage



This graph shows that on 16 (80%) out of 20 sites the company's concern about operatives; subcontractor's competence at the recruitment stage was high. On 4 (20%) out of 20 sites the company's concern about operatives, subcontractor's competence at the recruitment stage was medium.

Figure 31

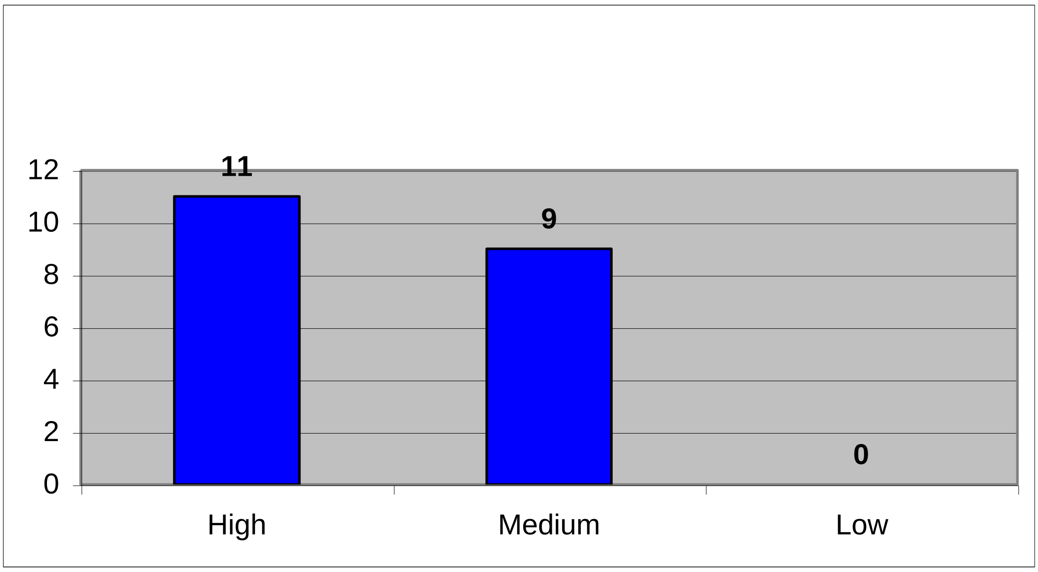
The company is concerned about manager/supervisors' competence at the time of recruitment?



This graph shows that on 12 (60%) out of 20 sites the company's concern was high about managers/supervisors competence at the time of recruitment. On 8 (40%) out of 20 sites the company concern was medium.

Figure 32

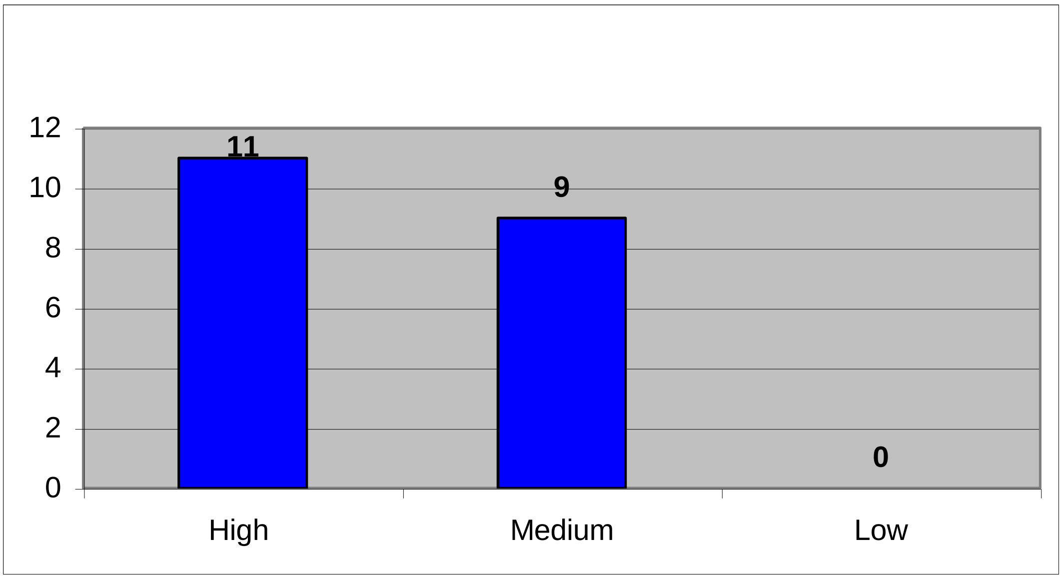
The company provides ongoing training to operatives



This graph shows that on 11 (55%) out of 20 sites the company provides ongoing training to operatives to a high standard. On 9 (45%) out 20 sites the standard was medium.

Figure 33

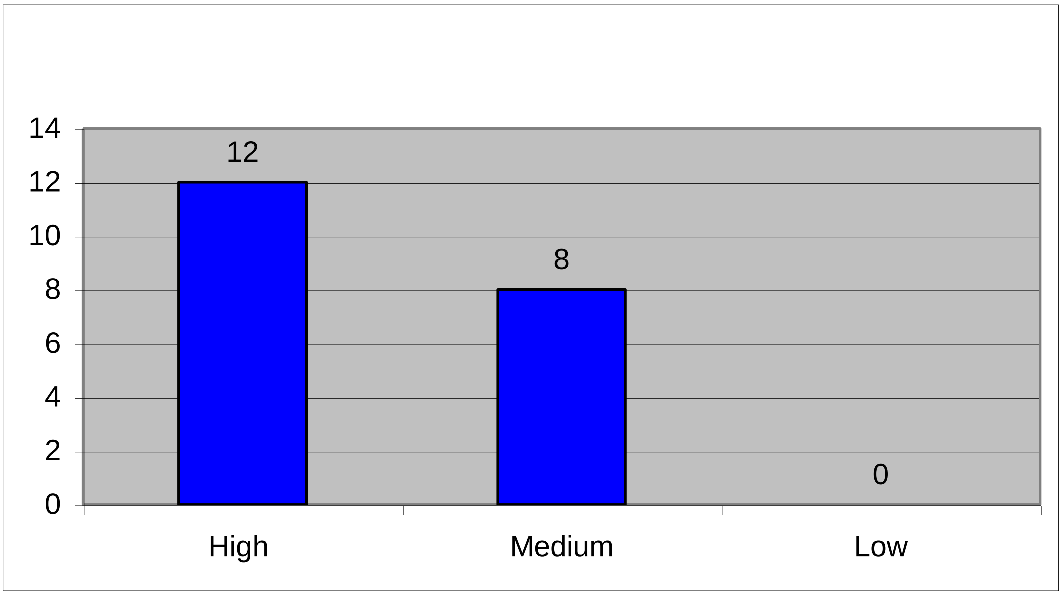
The company provides ongoing training for managers & supervisors



This graph shows that on 11 (55%) out of 20 sites the company provides ongoing training for managers & supervisors to a high standard. On 9 (45%) out of 20 sites the standard of ongoing training provided by the company for managers & supervisors was medium.

Figure 34

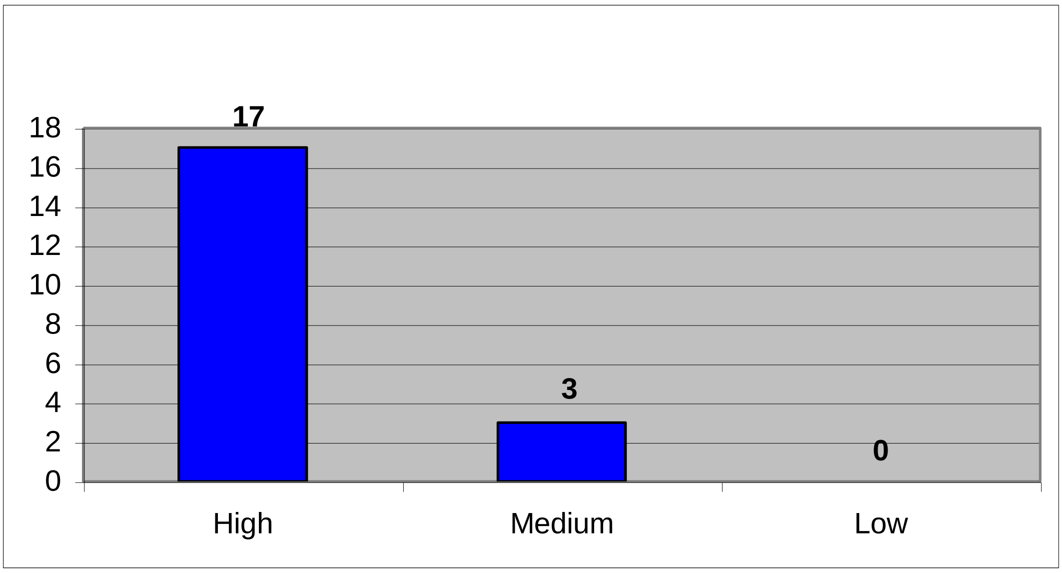
Frequency of audits carried out in the company



This graph shows that on 12 (60%) out of 20 sites the frequency of audits carried out by the company is high. On 8 (40%) out of 20 sites the frequency of audits carried out on site was medium.

Figure 35

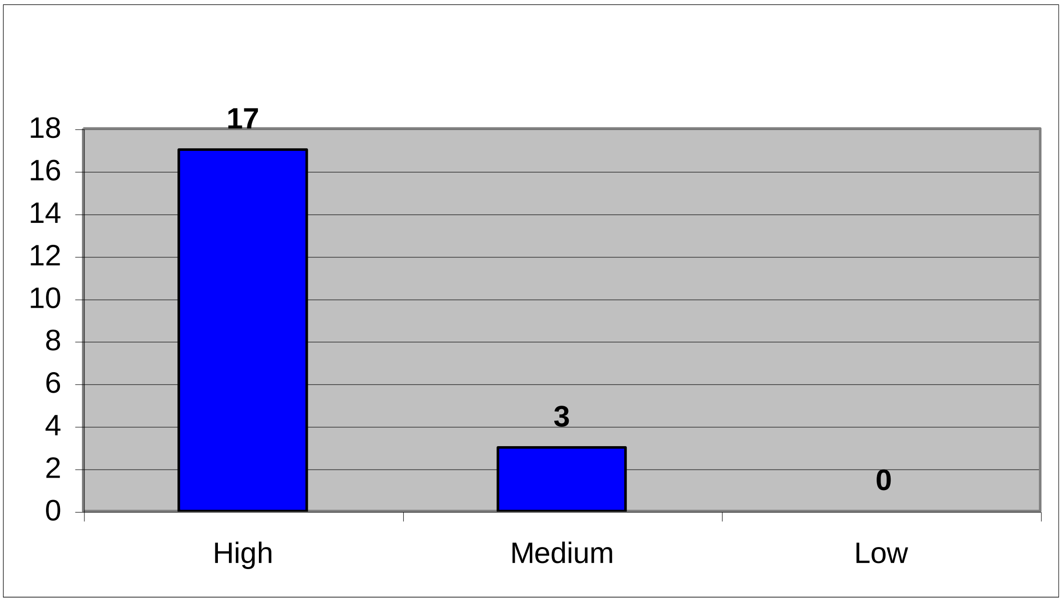
Effectiveness of audits to redirect organisational action



This graph shows that the effectiveness of audits to redirect organisational action was high on 17 (85%) out of 20 sites. On 3 (15%) out of 20 sites the effectiveness was medium.

Figure 36

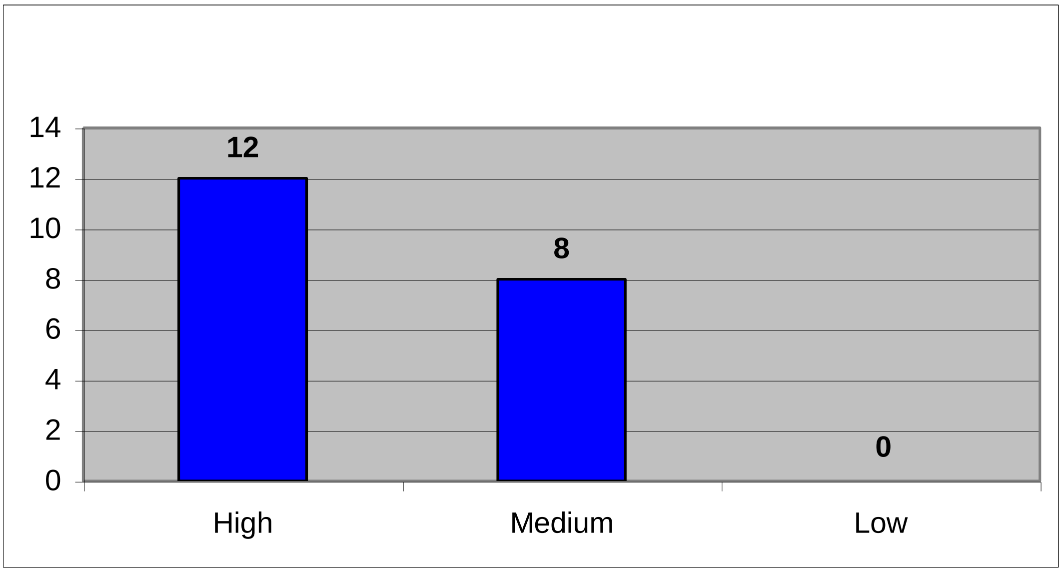
The quality of communication about safety in the workplace



This graph shows that on 17 (85%) out of the 20 sites visited the quality of communication about safety in the workplace was high. On 3 (15%) out of 20 sites the standard was medium.

Figure 37

Co-operation between the main contractor and sub-contractor

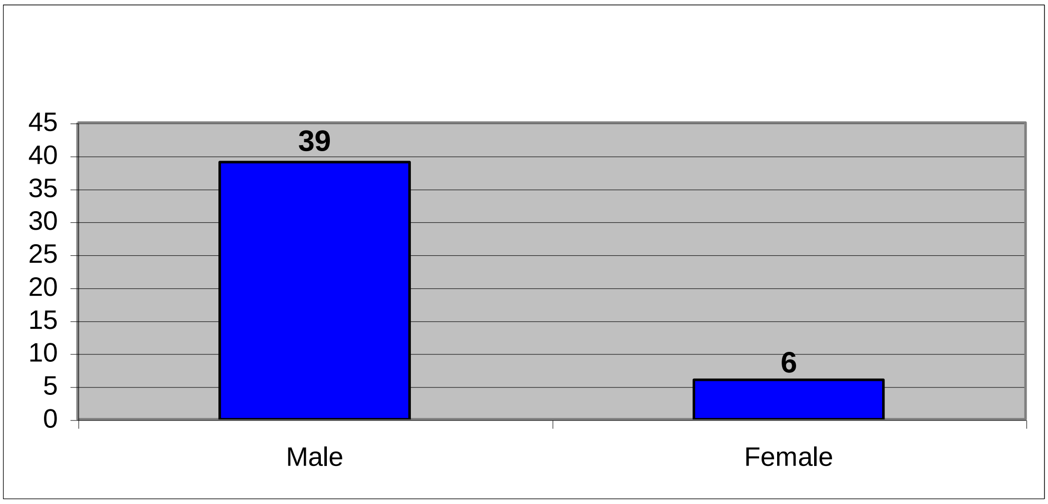


This graph shows that co-operation between the main contractor and sub-contractors were high on 12 (60%) out of 20 sites. On 8 (40%) out of 20 sites co-operation was medium.

4.7 Interviewees Background

Figure 38

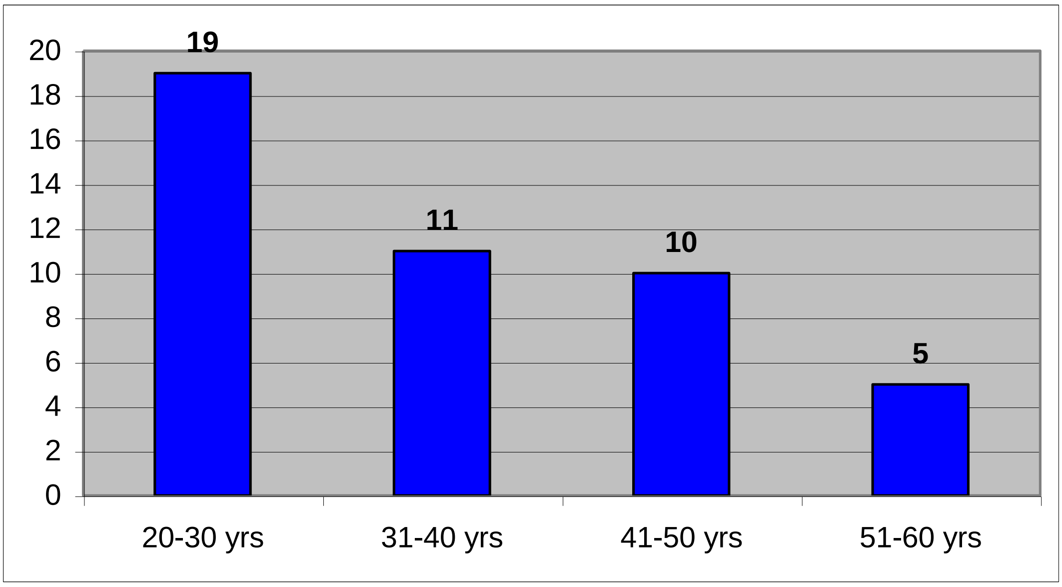
Gender of Interviewee



This graph shows that of the 45 interviewees 39 (87%) were male and 6 (13%) were female.

Figure 39

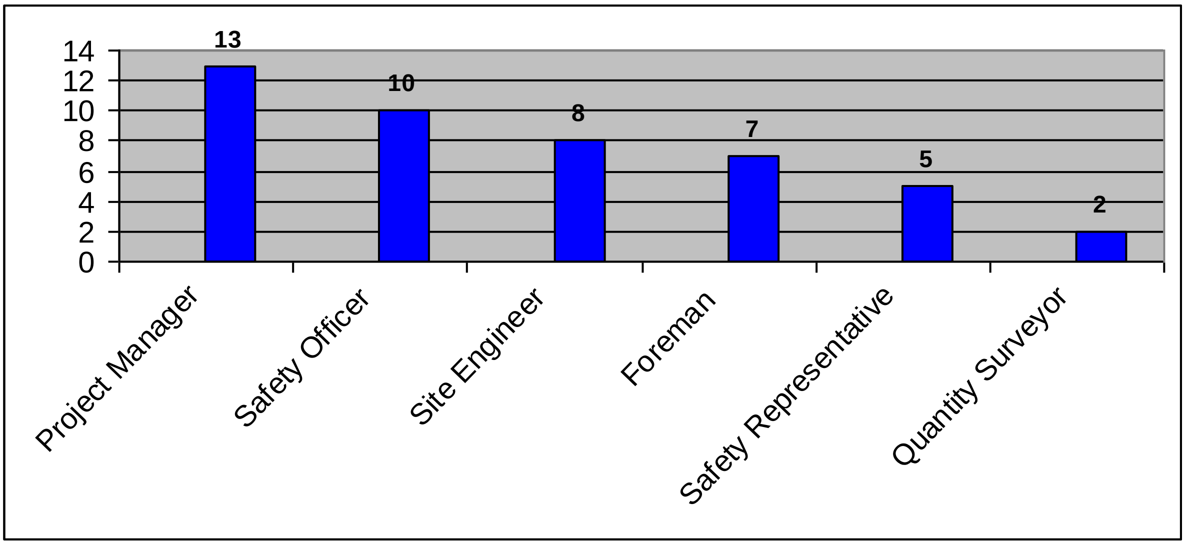
Age of interviewee



This graph shows that the majority, 30 (67%) out of the 45 interviewees were under 40yrs. with 19 (42%) out of 45 interviewees under 30yrs.

Figure 40

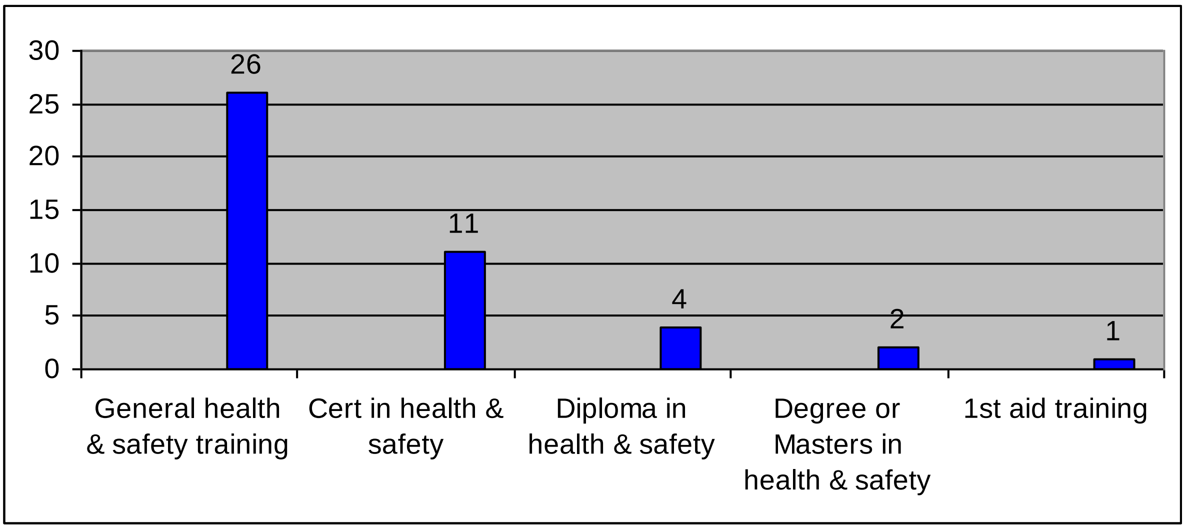
Job title of interviewees



This graphs shows that out of the 45 interviewees the majority 13 (29%) were project managers. The next largest group 10 (22%) were Safety Officers.

Figure 41

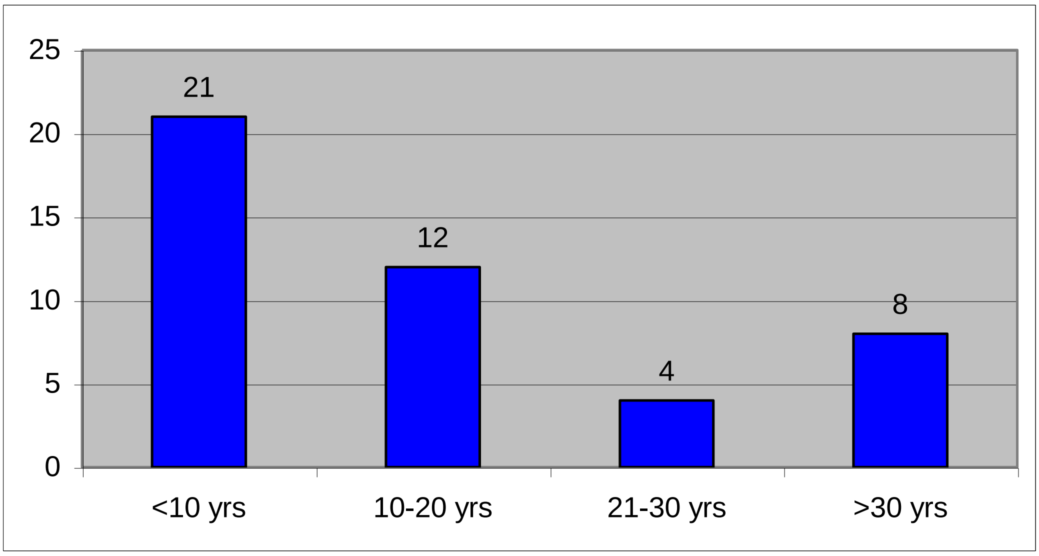
Interviewee training in health and safety



This graph shows that the majority of interviewees 26 (59%) received general health and safety training, which included safe pass training, managing safely training. Six out of forty five interviewee's had a high level of safety training of a Diploma or Masters in health and safety.

Figure 42

The number of years the interviewee has worked in construction



This graph shows that 21 (47%) out of the 45 interviewees had worked for less than ten years in construction. The majority of 33 (73%) interviewee's had worked for less than twenty years in construction.

4.7.1 Interviewee's questions summary

Improvements in construction safety.

All 43 interviewees out of 45 stated that there was a large or some improvement in safety in construction in the last 5 yrs. With regard to when improvements began 23 (64%) out of 36 respondents replied that improvements started on building sites during 2000-2001.

A total of 29 (71%) interviewees out of 41 stated that the three reasons in ascending order why safety standards improved on construction sites were

1. Greater awareness
2. Insurance company influence.
3. H.S.A. visits.

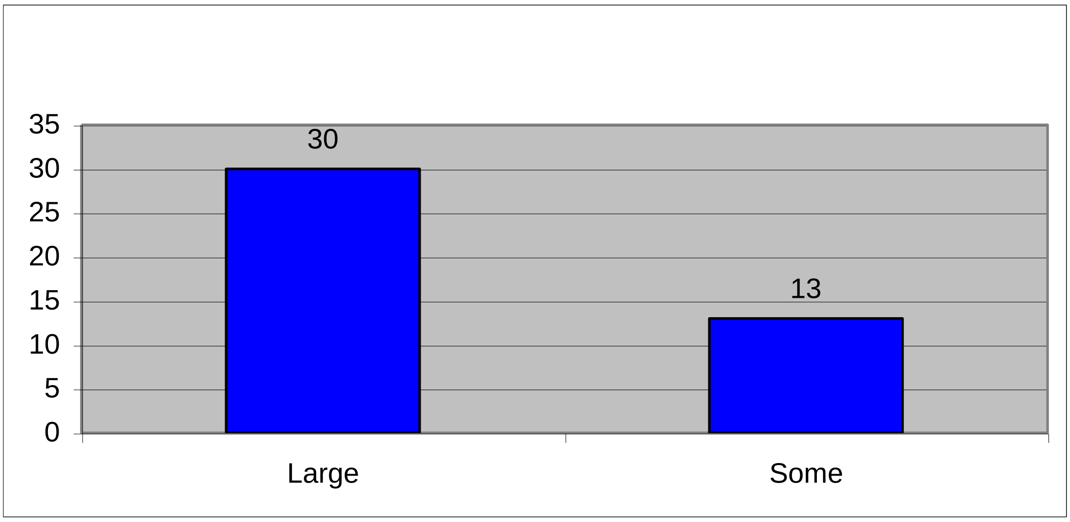
A total of 39 (93%) out of 42 interviewees stated that there was a large or some improvement in management's acceptance of responsibility of health and safety. A total of 38 (92%) out of 41 interviewees stated that there was a large or some improvement in the degree of worker consultation. A total of 35 (83%) out of 42 interviewees stated that there was a large or some improvement in safety training's influence on safety in the construction industry. All 36 respondents stated that there was a large or some improvement in the reporting of accidents.

However a total of 28 (68%) out of 41 interviewees stated that building designs have made no change, little improvement and in some cases have got worse in regard to being designed safer to build. Likewise a total of 25 (61%) out of 41 interviewees stated that the client influence to improve safety had made little or no change or got a little worse

4.7.2 Interviewee's Questions

Figure 43

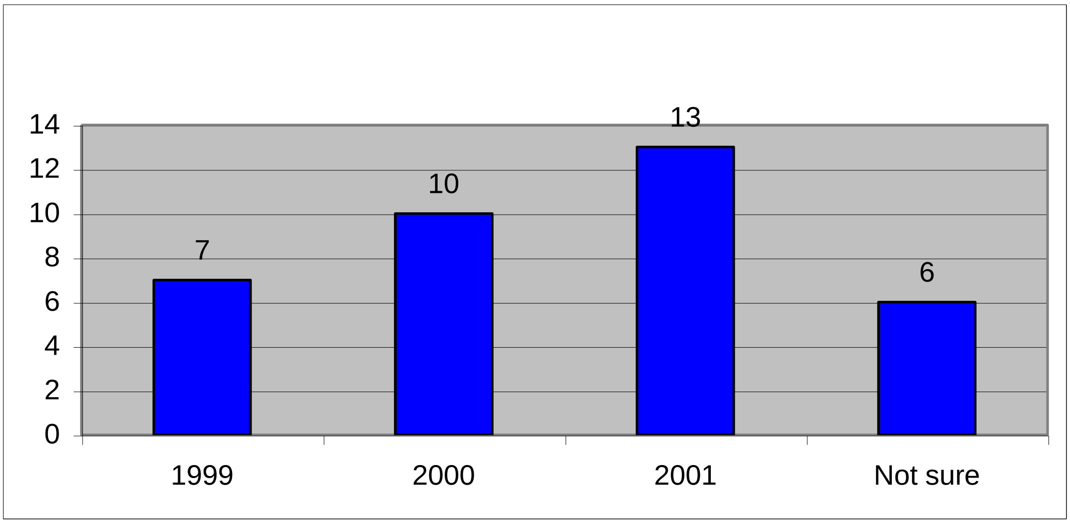
Has there been any improvement in safety in the construction industry in the last 5yrs?



This graph shows that 30 (70%) interviewees stated that there was a large improvement in safety in the construction industry in the last 5 yrs. Some improvement was chosen by 13 (30%) interviewees.

Figure 44

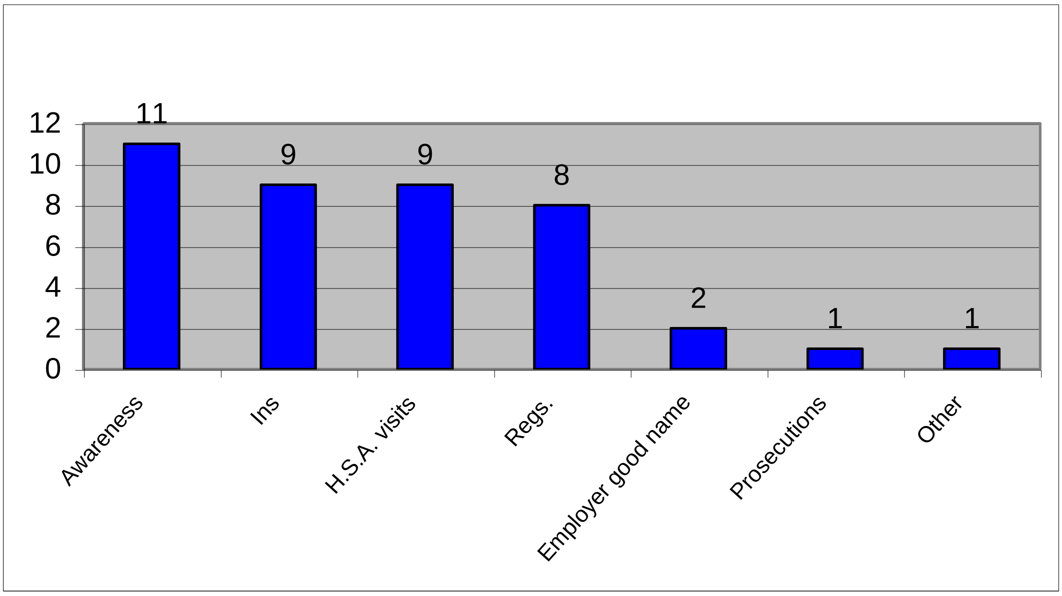
When did improvements start on building sites?



This graph shows that the majority of interviewees 13 (36%) choose 2001 as the year when improvements started on building sites. 10 (28%) interviewees choose the year 2000.

Figure 45

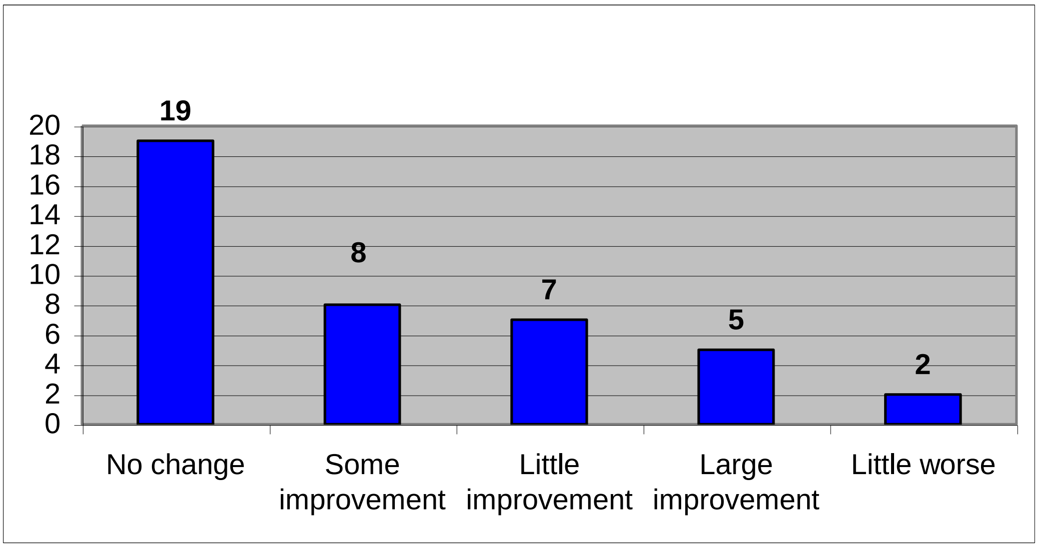
Why have safety standards on building sites improved?



This graph shows that the majority of interviewees (11) choose greater awareness as the reason why safety standards on building sites improved. Insurance and H.S.A. visits (9) was the next most popular reason.

Figure 46

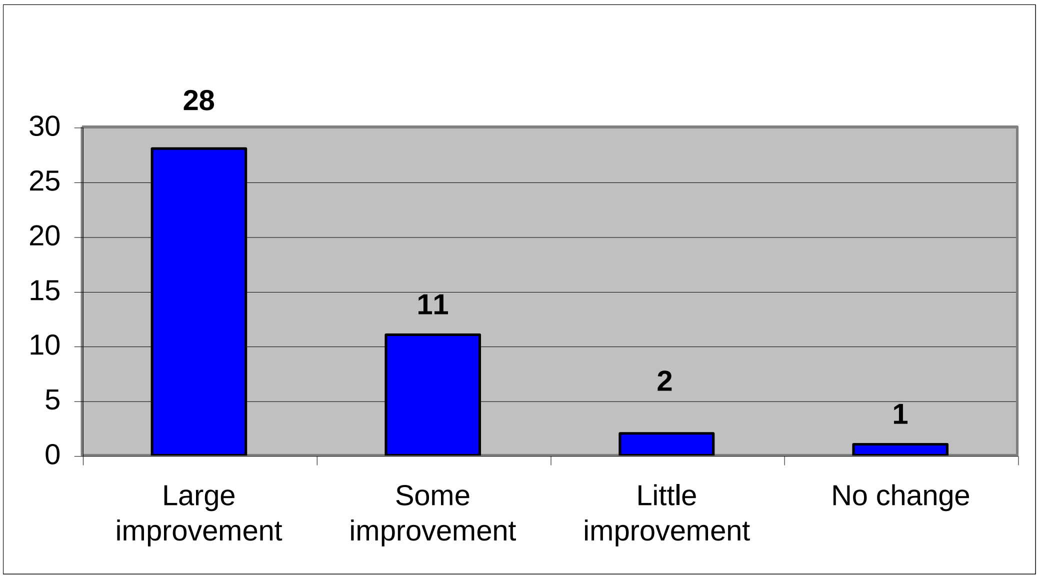
Are building designs safer to construct?



This graph shows that the majority of interviewees (19) choose that there was no change to making building designs safer to construct. 2 interviewees stated that building designs are now a little worse.

Figure 47

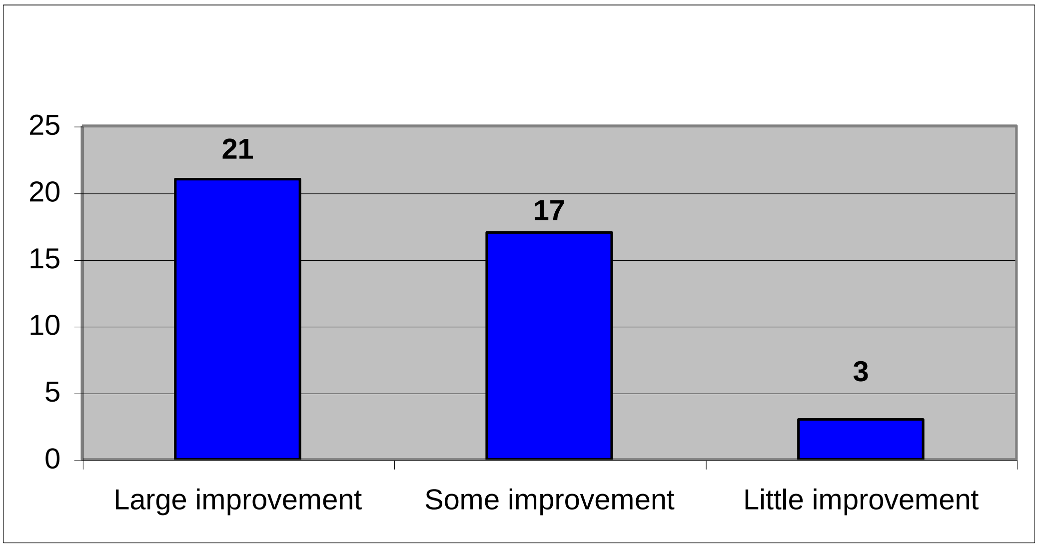
Acceptance of responsibility for Health & Safety by management



This graph shows that the majority of interviewees (28) chose a large improvement in safety management's acceptance of responsibility for Health & Safety. Some improvement was chosen by 11 interviews.

Figure 48

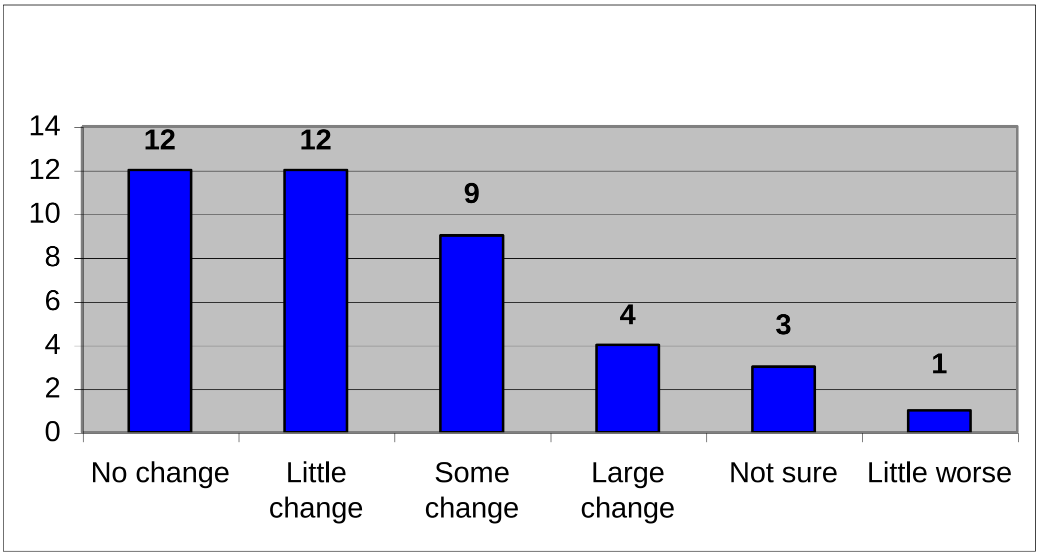
Degree of worker consultation



This graph shows that the majority of interviewees (21) chose a large improvement in the degree of worker consultation. Some improvement in the degree of worker consultation was chosen by 17 interviewees out of 41.

Figure 49

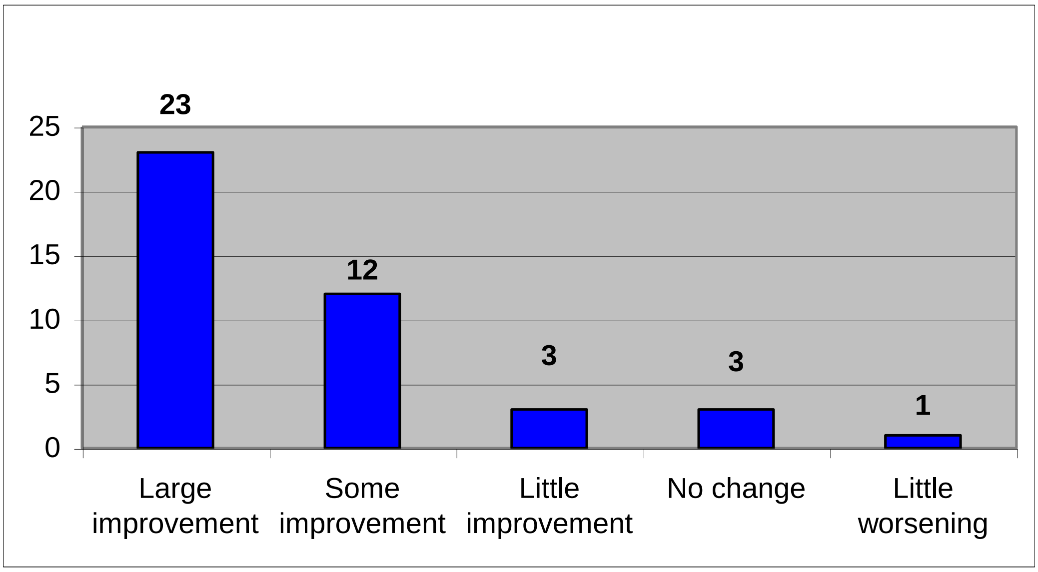
Client influence?



This graph shows that the majority of interviewees (12) choose no change in client influence and 12 chose little change in client influence.

Figure 50

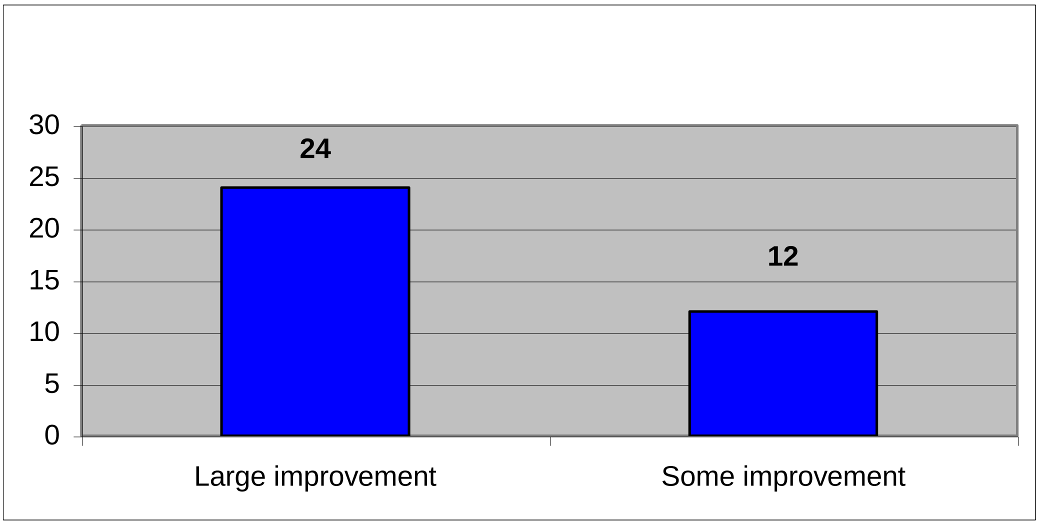
Influence of training



This graph shows that 23 interviewees chose a large improvement in the influence of training. Some improvements in the influence of training was choose by 12 interviewees.

Figure 51

Reporting of accidents



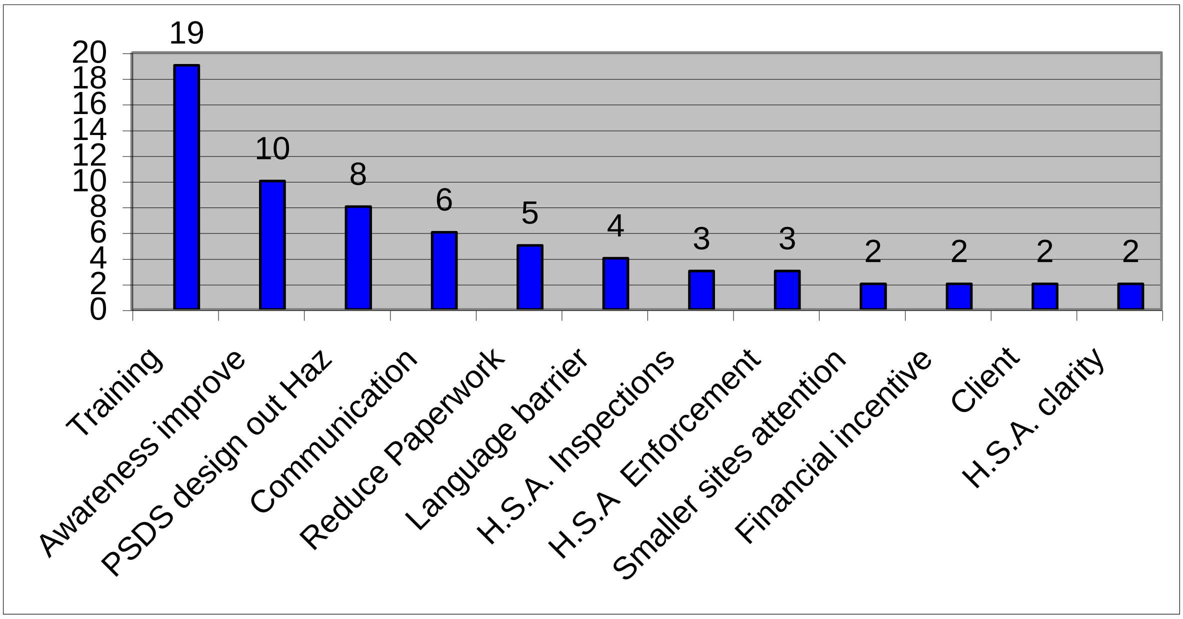
This graph shows that the majority of interviewees (24) choose a large improvement in the reporting of accidents. Some improvement was chosen by 12 interviewees.

4.7.3 Interviewee's suggestions to improve safety.

The majority or 42% of interviewees suggested training as the best way to improve safety. Secondly improving safety awareness was suggested by 24% of interviewees. Thirdly it was suggested by 18% of interviewees that the (PSDS) project supervisor design stage design out hazards at the design stage.

Figure 52

Interviewee's suggestions to improve safety.



This graph shows the interviewees suggestions to improve safety. The majority of interviewees suggested training as the best way to improve safety.

4.8 Factors associated with the five best sites?

1. Safety Representative.

Of the five overall best performing sites all of them had a health and safety representative**.** Of the five worst sites three out of the five sites had a health and safety representative.

Table 44

Safety representatives appointed on site and the comparison between safety representatives and the 5 best and the 5 worst sites for the overall 3 categories.

5 Best Sites for 3 Categories		**Full Time Safety Rep.**		**5 Worst Sites for 3 Categories**		**Full Time Safety Rep.**
Ranking	Site No	Yes / No		Ranking	Site No	Yes / No
1	9	Yes		20	14	No
2	12	Yes		19	3	Yes
3	15	Yes		18	18	Yes
4	7	Yes		17	5	No
5	8	Yes		16	2	Yes

2. Size of Construction Company in Ireland.

Of the five overall best sites for the 3 categories three of the sites were from construction companies that ranked in the top 50 construction companies in Ireland CIF (2005) Of the five overall worst sites for the 3 categories none of the construction companies ranked in the top 50 construction companies in Ireland. Hence the larger the construction companies the greater likelihood of higher safety compliance found on the site.

Table 45

The comparisons between the top 50 construction companies in Ireland and the 5 best and 5 worst sites.

5. Best Sites 3-Categories		**Top 50 Construction Companies**		**5. Worst Sites 3 Categories**		**Top 50 Construction Companies**
Ranking	Site No	Yes / No		Ranking	Site No	Yes / No
1	9	Yes		20	14	No
2	12	No		19	3	No
3	15	Yes		18	18	No
4	7	No		17	5	No
5	8	Yes		16	2	No

Pre-cast construction developments.

Of the five overall best sites two sites used pre-cast construction while none of the worst sites were pre-cast developments. However pre-cast construction was only used on three sites. This sample is too small to draw any firm conclusion.

Table 46

The comparison between pre-cast construction developments and the 5 best and 5 worst sites

5 Best Sites for 3 Categories		**Pre-cast Construction**		**5 Worst Sites for 3 Categories**		**Pre-cast Construction**
Ranking	Site No	Yes / No		Ranking	Site No	Yes / No
1	9	No		20	14	No
2	12	Yes		19	3	No
3	15	No		18	18	No
4	7	No		17	5	No
5	8	Yes		16	2	No

Housekeeping.

Of the five overall best sites for the 3 categories three (60%) sites were ranked in the five best sites in relation to housekeeping. Of the five worst sites for housekeeping compliance none of the sample was ranked in the five overall best sites for the 3 categories. Of the five worst sites for housekeeping compliance four sites or 80% of the sample ranked in the overall five worst sites for the 3 categories. In other words where housekeeping standards were high these sites in general were much more likely to have higher safety compliance standards generally. Likewise where housekeeping standards were low these same sites were much more likely to have lower safety standards generally.

Table 47

The comparison between the five housekeeping best sites and the overall five best and five worst sites.

5 Best Sites for 3 Categories		**Housekeeping**		**5 Worst Sites for 3 Categories**		**Housekeeping**
Ranking	Site No	Yes / No		Ranking	Site No	Yes / No
1	9	Yes		20	14	No
2	12	Yes		19	3	No
3	15	No		18	18	No
4	7	Yes		17	5	No
5	8	No		16	2	No

Table 48

The comparison between the five worst sites for housekeeping compliance and the overall five worst sites for the 3 categories.

5 Worst Sites for 3 Categories			**Housekeeping Worst sites**				**Housekeeping Worst sites**
Ranking	Yes		Ranking	Site No		Site No	Yes / No
20	14		20	14		14	Yes
19	3		19	2		2	Yes
18	18		18	3		3	Yes
17	5		5	5		5	Yes
16	2		9	19		19	No

PPE.

Of the overall five best sites for the three categories three (60%) sites of the sample were ranked in the five best sites in relation to PPE compliance. Of the five worst sites for PPE compliance none or 0% of the sample were ranked in the five overall best sites. Of the five worst sites for PPE compliance four sites or 80% of the sample ranked in the overall five worst sites for the 3 categories. In other words where PPE compliance standards were high on sites these sites in general were much more likely to have higher safety compliance standards generally. Likewise where PPE compliance standards were low these same sites were much more likely to have lower safety standards generally.

Table 49

The comparison between the overall five best sites for the three categories and the five best sites in relation to PPE compliance.

5 Best Sites for 3 Categories		**PPE**		**5 Worst Sites for 3 Categories**		**PPE**
Ranking	Site No	Yes / No		Ranking	Site No	Yes / No
1	9	Yes		20	14	No
2	12	Yes		19	3	No
3	15	Yes		18	5	No
4	7	No		17	18	No
5	8	No		16	10	No

Table 50

The relationship between the five worst sites for PPE compliance and the five worst sites for the overall three categories.

5 Worst Sites for 3 Categories			**PPE Worst sites**				**PPE Worst sites**
Ranking	Yes		Ranking	Site No		Site No	Yes / No
20	14		20	14		14	Yes
19	3		19	3		3	Yes
18	18		18	5		5	Yes
17	5		17	18		18	Yes
16	2		16	10		10	No

Falls from Heights.

Of the five best sites four (80%) of the sample were ranked in the best sites in relation to falls. Of the five worst sites for falls compliance 1 site or (20%) of the sample were ranked in the five overall best sites. Of the five worst sites for falls compliance one site (20%) of the sample ranked in the overall five worst sites. In other words where fall from height prevention standards were high on sites these sites in general were much more likely to have higher safety compliance standards generally.

Table 51

The comparison between the overall five best sites & five worst for the 3 categories and the 5 best sites in relation to falls from height.

5 Best Sites for 3 Categories		**Falls from height**		**5 Worst Sites for 3 Categories**		**Falls from height**
Ranking	Site No	Yes / No		Ranking	Site No	Yes / No
1	9	Yes		20	14	No
2	12	Yes		19	3	No
3	15	Yes		18	18	Yes
4	7	No		17	5	No
5	8	Yes		16	2	No

Table 52

The comparison between the overall five worst sites for the 3 categories and the 5 worst sites in relation to falls from height.

5 Worst Sites for 3 Categories			**Falls Worst sites**				**Falls Worst sites**
Ranking	Yes		Ranking	Site No		Site No	Yes / No
20	14		20	16		16	No
19	3		19	6		6	No
18	18		18	18		18	Yes
17	5		5	1		1	No
16	2		9	10		10	No

Site Management.

Table 53

The levels of site management controls, comparison between the 5 best sites and the 5 worst sites for the overall 3 categories

Management controls	5 Best sites		5 Worst sites	
	High	Medium	High	Medium
Concrete plan of action to handle safety?	5		5	
The company is concerned about operatives, subcontractors' training /competence at the recruitment stage?	4	1	3	2
The company is concerned about managers/supervisors' competence at the time of recruitment?	4	1	1	4
The company provides ongoing training to operatives?	4	1	2	3
The company provides ongoing training for managers & supervisors?	4	1	2	3
Frequency of audits carried out in the company?	4	1	2	3
Effectiveness of audits to redirect organisational action?	5		3	2
H.S.A. Inspections?	N/A	N/A	N/A	N/A
The quality of communication about safety in the workplace?	5		2	3
The assumption of responsibility by the main contractor for all safety in the workplace?	5		5	
Co-operation between the main contractor and sub-contractors?	4	1	1	4
Totals	**44**	**6**	**26**	**24**

In conclusion the five best sites had much higher levels of management control on site. The five best sites had high levels of management control for 44 out of the 50 management variables with medium management controls for 6 of the 50 variables for the 5 sites. In comparison the five worst sites had high levels of management controls for only 26 out of the 50 management variables and had medium management controls for 24 out of the 50 management variables for the 5 sites.

Table 54

The 5 best sites for the overall 3 categories had much higher levels of management control on site when compared to the overall 5 worst sites.

Site Management controls (Overall 3 Categories.)		
Management controls	5 Best sites	5 Worst sites
High	44	26
Medium,	6	24

Table 55

The level of site management controls, comparison between the 5 best sites and the 5 worst sites for the overall 3 categories for 3 different management control variables.

Management controls	5 Best sites		5 Worst sites	
	High compliance	Medium ompliance	High compliance	Medium compliance
7. Effectiveness of audits to redirect organisational action?	5		3	2
9. The quality of communication about safety in the workplace?	5		2	3
11. Co-operation between the main contractor and sub-contractors?	4	1	1	4
Totals	**14** (93%)	**1** (7%)	**6** (40%)	**9** (60%)

When comparisons are drawn between management controls on the best five sites and the worst five sites this research shows more difference in management controls in the above three areas namely,

1. The effectiveness of audits to redirect organisational action.
2. The quality of communication.
3. Co-operation between the main contractor and sub-contractor.

5 Discussion

5.0 Discussion

5.1 Overall safety performance for the twenty sites.

In overall terms the level of safety performance on the twenty sites was variable. The most positive findings were that a quarter of the sites (five in total) achieved good compliance with recommended safety practices and a complete prevention of falls. Also certain safety practices such as adequate documentation was seen on all sites. However no sites achieved total compliance with all required safety practices. Unfortunately fifteen sites out of twenty did not achieve adequate falls from height prevention measures and this remains an area of concern. The best level of compliance found in employees with regard to safety practices was the wearing of personal protective equipment which was generally of a high standard.

The majority of instances of inadequate falls from height protection was seen at the highest point of the building during the survey visit or at roof level. This indicates that the majority of opportunities for employees to fall is linked to the highest point of the construction stage and generally involved carpenters block & brick layers, roofers, scaffolders and carpenters.

Housekeeping was the least compliant area for safety and no site achieved full safety compliance. However ten sites out of twenty achieved good standards with less than 5% non –compliance with good housekeeping practices. Sixteen sites out of twenty recorded less than 5% non-compliance with the wearing of personal protective equipment.

The five sites that achieved complete falls from height prevention also performed better in overall terms with regard to the remaining categories of housekeeping and PPE. In effect these sites tended to have a higher level of compliance across all categories of site safety. Consequently the remaining fifteen sites were found to have a lower level of safety compliance across all categories. This finding indicates that the management systems found on these sites is as least identifying all aspects of safety and the implementation of risk management is generally equally distributed across all hazards. This also has to be seen in a positive light as it indicates that safety issues are being treated in their entirety rather than as separate components. It also shows another positive finding in that when risk management is successfully implemented it tends to benefit all safety issues and does not leave certain safety practices ignored or less prioritised.

A comparison can now be made with the McDonald & Hrymak (2002) study to assess any progress in safety standards since 2002. In the McDonald & Hrymak (2002) study only two sites out of twenty achieved adequate fall prevention. This study showed that five out of twenty had achieved adequate fall prevention. This is a welcome but modest increase. However this increase should be seen in a positive light as it shows an improvement in an industry noted for its poor safety record. Therefore this finding is encouraging. The small sample size of both studies and the fact that the sites in this study are Dublin based rather than nationwide is noted. Nevertheless the improvement seen in this study is welcome especially given the sample size of this research which is representative of the apartment construction industry in the Dublin area. Furthermore the poorest levels of safety found in this study were not as bad at the poorest performing sites found in the McDonald & Hrymak (2002) study. Hence this study can also report another improvement in that the number of poorly performing sites has decreased.

McDonald & Hrymak (2002) asserted in their study that they achieved a reasonable level of representativeness in their sample. Therefore whilst this study and the McDonald & Hrymak (2002) study cannot be directly compared, the similarities and difference can be said to be generally indicative of the construction sites they represent.

Another improvement seen on these sites when compared to the McDonald & Hrymak (2002) study is the increase in safety representation. In this study, sixteen out of twenty sites had safety representatives. In the McDonald & Hrymak (2002) study six out of twenty had safety representatives. As the McDonald & Hrymak (2002) study showed a strong correlation between the presence of site safety representative and good safety performance, this increase in the number of safety representatives is a welcome improvement. In addition this increase in the number of safety representatives found in this study represents the greatest increase in safety performance seen between the two studies.

It is interesting to argue that this increase in safety representatives is responsible for the increase in safety performance seen in this study. This would be a plausible explanation; however the small sample size in this study means that a firm conclusion cannot be drawn here. There has been a welcome improvement in site safety in Ireland as evidenced by the fall in construction site fatalities since 2002 (Health and Safety Authority 2005 Annual Report). No other reason in the literature stands out as being primarily responsible for this improvement. The interviewees in this study gave no overwhelming reason for this. Instead a variety of reasons were given with the more frequent responses (10 interviewees each out of 39) included awareness, insurance requirements, regulatory activity and legal requirements. None of these reasons given would mutually exclude the activities of safety representatives; rather it could be argued that that a safety representative would facilitate all of these reasons. Also it should be remembered that by law construction sites with more that 20 employees require a safety representative. Hence this study provides evidence of the role a safety representative can bring to improving site safety. However until twenty similar sites without safety representatives can be studied, this link must remain as strong speculation with supporting evidence.

There were a number of other similarities found between this study and the McDonald & Hrymak (2002) study. Site documentation was good for all twenty sites in this study showing that the level of documentation on sites did not reflect safety performance. This finding is similar to the McDonald & Hrymak (2002) study which also found that site safety documentation did not predict good site safety performance. However this increase in documentation should also be seen in a positive light as it indicates a higher standard of compliance with required site safety documentation.

Another similarity between these studies in the effect of regulatory activity on the sites. In this study visits to the site by the Health and Safety Authority did not reflect the level of safety performance found.

5.2 Factors associated with the best five sites.

One factor that strongly characterised the five sites in this study that performed well was company size. The best performing sites were those operated by the biggest construction companies among the group. Hence the bigger the construction company the better the safety performance. Of the five best sites, three were from construction companies from the top 50 construction companies in Ireland as listed by size, by the Construction Industry Federation. Of the five worst sites none were in the top 50

This finding is consistent with CSA (2003) research from Purdue University's School of Health Sciences which conducted a study to determine what elements of the safety programmes of large construction companies were responsible for a reduced rate of falls in comparison to small construction companies (Construction Safety Alliance, 2003). The results from this survey can be summed up in three terms: motivation, training and money. The primary reason for given the success of large construction companies at reducing construction falls with that upper management had made a commitment to be safe. Hinze et al. (2002) also showed that the rate of falls decreased as the cost of construction projects increased.

Harper et al (1998) states that the larger construction companies have more resources and are best placed to fund safety programmes when compared to smaller construction companies. This US based research also showed that the accidents and incidence rates were substantially reduced as the investment in safety was increased.

Another factor that characterised the best performing sites, though not as strongly as size, is the number of safety representatives on site. The five best performing sites all had safety representatives. This is opposed to the relatively worst performing five sites where three sites had site safety representatives. Although this factor is not as strongly correlated as size due to the small number of sites and safety representatives in the sample, it is nevertheless as mentioned above, a plausible explanation when taking the literature into account, to say that site safety representatives play an important role in site safety.

Abraham et al (2004) also noted one provision that the contractor must assign at least one full-time safety representative to the construction site. Jaselskis et al (1996) also recommended that safety representatives should spend 30-40% of their time on safety issues. He stated that expending less time may compromise the project safety outcome.

One other factor found on the best performing sites was the use of pre-cast concrete in construction. This was used on three out of the five best performing sites. This may be a factor but the numbers are too small to draw any firm conclusions other that to say that the use of pre-cast concrete may lead to better safety standards due to the way it is used. However there is literature to support this view especially with regard to preventing falls from heights.

Hinze et al (1997) in a study carried out for the Construction Industry Institute identified over four hundred design suggestions to increase worker safety. One of the major suggestions was to design components to facilitate prefabrication in the shop or on the ground so that they may be erected in place as completed assemblies. The purpose of this was to reduce worker exposure to falls from elevations and the risk of workers being struck by falling objects. Gibb et al (1997) stated that "it is not inconceivable that everything except the basic structure of an office building could be prefabricated in the near future".

Other factors which may influence the level of site safety found in this study were presented by the site management to improve site safety. Three main factors given by them as possible motivating factors to improve safety were in ascending order training (40%) followed by improving awareness (24%) and eliminating hazards at the design stage (18%)

With regard to basic safety training for construction site employees the construction industry can be said to be well trained. The FAS safer pass initiated under the Construction Safety Partnership Scheme (H.S.A. 2002b) has achieved very high rate participation. Under this scheme construction employees receive a basic one day course in site safety. This training is a legal requirement. So it can be argued that this training requirement as stated by the interviewees is already ongoing.

Improving awareness is a somewhat vague term which would seem to include training as a component. Hence this finding cannot be interpreted very clearly. However the suggestion of improving the designs of buildings so that they are less hazardous to build is more promising.

5.2.1 Eliminating hazards at the design stage.

It was suggested by 18% of interviewees that the project supervisor design stage could eliminate hazards at the design stage. An example of this would be the use of prefabricated units for example pre-cast concrete walls. This idea shows three findings. Firstly that the interviewees believed that the decisions at design stage can influence site safety, secondly that site hazards are present due to decisions made at the design stage, thirdly that more can and should be done at the design stage to improve site safety. However interviewees stated that there was little or no improvement in buildings being designed so that they are safer to build in the last five years.

There is a good deal of literature to suggest that eliminating hazards at the design stage is feasible.The Health and Safety Executive in the UK has identified that much more can be done for the elimination of hazards at the design stage. According to them, 'it is only by considering health and safety issues from the earliest stages that designers can take full advantage of the opportunities for avoiding hazards on site (HSE, 1995).

Carruthers (2002) refers to research conducted by the Institute of Civil Engineers in the UK which showed that '75% of all engineers working on design believed that more could be done to design out risks during construction'.

The Construction Industry Institute focused on creating a database of safety ideas and a design tool that allows designers to address construction worker safety in their designs. Four hundred design suggestions have been accumulated in this research. The majority of design suggestions or (32.8%) related to falls.

The HSA (2002) survey reported an urgent health and safety training need for designers. The survey revealed that only 10% of designers of Project Supervisor Design Stage had any health and safety qualification. According to the H.S.A. (2002) report this is in many ways the most worrying result of the entire survey. The overwhelming majority of members of the design professions do not have any recognised formal health any safety training This lack of training was stated as one of the primary causes for the poor understanding of designers in relation the understanding of their statutory duties and of their general failure to implement general principle of prevention.

The H.S.A. (2002) report states that it is generally recognised that designers have a key role to play in helping to prevent accidents on sites. The HSE (1995) report that there is potential for the elimination of hazardous conditions at this stage for designers of smaller building projects state that 'it is only by considering health and safety issues from the earliest stages that designers can take full advantage of the opportunities for avoiding hazards on site'.

The H.S.E. (2004) published a report which carried out research in analysing actual incidents with respect to designer involvement. That report concluded that almost half of all accidents in construction could have been prevented by designer intervention. There was also sufficient evidence to support a prosecution of the designer in almost half of the cases analysed. At least 1 in 6 of all incidents is at least partially the responsibility of the lead designer in that opportunities to prevent incidents were not taken. According to the European Agency for Safety and health at work (2005) up to 60% of the accidents on Europe's construction sites and over 25% of the fatalities could be avoided by more careful design, planning and procurement before construction starts.

It is interesting to note that the interviewees did not see regulatory activity including the role of the client as being an important ways of improving site safety. The finding that regulatory activity is not a principle factor in predicting safety is similar to findings in the McDonald & Hrymak (2002) study. Therefore it is not surprising that client influence is also seen as minimal as this in itself requires a regulatory input to ensure enforcement of legal requirements. However the role of the client in achieving site safety has received much attention in recent years. The recent Safety Health and

Welfare at Work Act 2005 now has specific regulations requiring the client to influence site safety at the design stage by appointing competent designers.

Also there is a good deal of literature advocating increasing the influence of the client on subsequate site safety standards. Data from the Health and Safety Authority suggests that a significant proportion of clients are failing to meet their obligations, (H.S.A. 2003) Previous research on construction fatalities revealed that supervisors were not appointed on 45% of sites where fatalities occurred between 1991 and 2001 (HSA, 2003). The figures for the Irish submission to the European Construction Campaign (2003) indicate that project supervisors were not appointed on 18% of applicable sites.

According to the Health and Safety Executive in the UK HSE (2002), the client can set the tone of the entire construction project and their choice of duty holders and contractor reflects their priorities with regard to safety and production. The Health and Safety Executive in the UK, HSE (2002) estimates 'that 60% of fatal accidents are attributable to decisions and choices made before the work began (H.S.A. 2002).

The Health and Safety Authority state that "It is the client's attitude to safety that has most impact. As they have the opportunity to emphasise safety through contact with the design and construction teams" H.S.A (2002).

5.2.2 Interviewee's perceptions regarding safety compliance in construction in the last 5 yrs.

All of the interviewees stated that there was a large or some improvement in safety in the construction industry in the last 5 yrs. and the majority of interviewees stated that those improvements started during the period 2000-2001.

The majority of interviewees were in agreement that there was a large or some improvement in the construction industry in relation to, management's acceptance of their responsibility for health and safety on construction sites, consultation with employees on site, reporting of accidents, and training.

This is a welcome finding as previous research has found that management's involvement and commitment to construction site safety is essential to improve safety performance. Rodgers et al. (1993), found that "studies have consistently reported that commitment from top management is essential" for safety interventions to succeed.

Management's commitment is a central element of the safety climate (Zohar 1980). Langford et al. (2000) found that when employees believe that the management cares about their personal safety, they are more willing to cooperate to improve safety performance. Jaselskis, et al (1996) found that projects that achieve average and outstanding project results had strong upper-management support. Likewise where projects achieved below average results management support was weaker.

Mohamed (2002) found that empirical results indicate a significant relationship between the safety climate and safe work behaviour. Positive safety climates seem to result from management's showing a committed and non-punitive approach to safety. Management can also promote a positive safety climate by encouraging a more open free-flowing exchange about safety related issues.

5.2.3 Consultation with employees.

Interviewee's also reported a large improvement in consultation with employees on building sites in the last 5yrs. This again is a welcome finding as there is literature to support the idea that increased consultation improves safety standards. Harper et al (1998) found that increased consultation with employees on site and increased employee involvement resulted in improved safety performance and increased responsibility for employees. It is generally known that employees are often more aware of hazards in the work place than are employers (Koehn and Surabhi, 1996). By involving the employee in the safety process, more commitment is gained from the employee. This additional commitment may be attributable to the employee's desire to execute something, which he or she has developed or assisted in developing. This type of involvement enables the employees to gain a sense of ownership and increased responsibility. Employees are more apt to accept and adapt to minor changes implemented into a safety programme through time than they are to accept vast changes thrown upon them at short notice (Paterson, 1996).

Again employee involvement is key here. In most instances it is the employees who are most knowledgeable about the potential hazards peculiar to their work as well as ways to avoid these hazards. Management need only tap this knowledge held by the employees. Also, with employee involvement changes may be made much more efficiently than by forced implementation with no input from the employees (Harper et al, 1998).

Improvement in employee consultation is shown by a number of previous researches to be consistent with improved safety performance in construction. This may be a contributory factor in the role of safety representatives in improving safety.

5.2.4 Reporting of accidents.

The results in the interviews showed that there was a large or some improvement in the reporting of accidents. Previous research has shown that keeping accident records had a positive influence on safety performance. Levitt and Parker (1976) found that those contractors who do not keep accident records by project averaged incident rates, which are about double those rates found in companies that do keep these records by project. They, too, saw that the accident rates for contractors that keep records of accidents by project were substantially lower than those of the companies that do not keep these records. Improved reporting of accidents can have positive effects on improved safety performance.

6 Recommendations and Conclusions

6.1 Conclusions

The level of safety found on the twenty construction sites was variable. Using the criteria of preventing falls from heights as a measure of site safety, a quarter of sites site were found to have high standards of safety. This represents a modest but welcome improvement on the findings of a similar nationwide study carried out by (McDonald and Hrymak, 2002).

The most important improvement found on these twenty sites compared to the McDonald and Hrymak study is a significant increase in the presence of safety representatives which again is a welcome development. Other improvements include an increase in relevant site safety documentation and an increase in the wearing of personal protective equipment.

The best performing sites in this study in terms of safety performance were characterised by the company size. The bigger the company, the better the safety standards found. Also site safety standards were uniform in their spread. Where a site was found to have high levels of compliance with recommended safety practices, this compliance was across all safety issues. Where a site had lower levels of safety performance, it was found across all safety issues. This suggests that the management systems being used are covering all aspects of safety equally well.

The question that now arises from this study is how to improve site safety, which according to the Health and Safety Executive in the UK readily solvable. They state that the types of incidents that lead to injuries and fatalities in the construction industry are "foreseeable and preventable. They state that "We have known for years how to prevent them, but they often happen in the same old ways. The circumstances of such incidents as reported are not complex, usually involving a fall from scaffolding or roof, or through fragile roof materials. The prevention of falls from heights does not require sophisticated engineered defenses. The preventative measures are simple, but remain under-utilised. Therefore, it is not risk identification or risk assessment particularly that is the problematic in the construction context but rather the risk response".

Given the way construction sites are operated and regulated at present, safety representatives still seem the best solution to improving site safety. Designing out hazards offers good prospects if enforcement can be improved. But this is a circular argument as enforcement is difficult to achieve due to current resource constraints. Also it can be argued that if existing safety rules are more actively enforced site safety could improve. This is not a criticism of the Health and Safety Authority as they can only operate within their resource allocation. The number of Health and Safety Authority Construction site inspectors in 2002 was approximately twenty (McDonald and Hrymak , 2002), Given that the size of the construction industry in 2005 involved nearly 250,000 employees, CSO (2005), the ratio of inspectors to sites quickly becomes apparent.

Therefore enforcement as currently practiced does not seem the best way forward. Taking this study into account together with Mc Donald and Hrymak (2002) study and all relevant literature, persuading construction firms to increase the number and influence of safety representatives seems to offer the best prospect for safety improvements in the short term.

6.2 Recommendations

This research like previous research has identified the potential positive influence that safety representative can play in influencing safety compliance on construction sites. All constructions sites should have safety representatives and their role and functions should be reinforced, including more formal defined roles and sufficient time allocated on site to carry out these roles.

The site observational methodology worked well in measuring safety performance during this research. However the methodology could be enhanced and improved for use on all construction sites by including plant and machinery and all other construction site activities.

By adapting this framework of research a more accurate indicator of the level of safety compliance on construction sites at a national level may be obtained, a measure of safety levels on smaller sites can also be achieved

Future research into the construction industry should place particular attention on the role of the safety representative within the construction industry especially where safety representatives were shown to have greater influence on improving safety compliance. Further research should endeavour to establish trends and factors like competence, training, selection by management or employees and the time allocated on each site to allow the safety representative to carry out their roles.

Appendix A

Construction Site Observational Checklist

Construction Site Checklist.

Site: **Number**

Start Time: **Finish Time:**

Date: **Observer:** Paul Mc Evoy

1. Employees working on site =
2. Managers on site =
3. Stage of work,
4. Commencement date - Completion date

Number of Apartments. =
Number of blocks &
stage of work for each block.

Yes = Compliance. **No = Non Compliance** **N/A = Not applicable** **% = % Of non Compliance**
A = Excellent **B = Good** **C = Fair** **D = Poor**

Compliance	Item	Yes	No	N/A	A	B	C	D	%	**Remarks**
1. Scaffolding.										
Scaffolding on sound footing?	1									
Base-plates & sole-boards used?	2									
Platforms properly supported?	3									
Scaffolding braced properly?	4									
Scaffolding tied properly?	5									
Ladder access provided?	6									
Platforms fully boarded?	7									
Handrails in place & mid-rails where necessary?	8									
Toe-boards in place?	9									
Platforms kept clean?	10									

Trap boards	11									
Brick-guards in place?	12									
Trestles used properly?	13									
Platforms loads within S.W.L.?	14									

Compliance	**Item**	**Yes**	**No**	**N/A**	**A**	**B**	**C**	**D**	**%**	**Remarks.**
2. Ladder access to heights										
Proper ladders in use?	15									
Ladders in good condition?	16									
Positioning properly & extend 1m above landing?	17									
Properly secured?	18									
Ladders used safely?	19									
Stepladders used safely & fully open?	20									

Compliance	**Item**	**Yes**	**No**	**Yes**	**A**	**B**	**C**	**D**	**%**	**Remarks.**
3. Mobile scaffolds										
All boards in place?	21									
Guardrails fitted properly?	22									
Toe boards fitted properly?	23									
Safe means of access?	24									
Ground firm & level?	25									
Tower tied to building if unattended?	26									
Wheels locked?	27									
Base height ratio O.K. e.g. (1-3)?	28									
Clear of people & material when being moved?	29									
Scaffold used safely	30									

Compliance	Item	Yes	No	N/A	A	B	C	D	%	Remarks.
4. Workplace access.										
Clear Access routes?	31									
Safe footing?	32									
Adequate width?	33									
Route signage?	34									
Floor edges / openings / voids protected?	35									
Manholes / access opens protected?	36									

Compliance	Item	Yes	No	N/A	A	B	C	D	%	Remarks.
5. Housekeeping										
Scaffold base free of rubbish	37									
Scaffold lifts free of rubbish	38									
Materials stored neatly & safely	39									
All access routes & stairways rubbish free	40									

Compliance	Item	Yes	No	N/A	A	B	C	D	%	Remarks.
6. Roof work										
Warning notice on approach to fragile roof?	41									
Are crawling boards in place?	42									
Edge protection in place?	43									
Guardrails in place?	44									
Toe boards in place?	45									
Anchorage points for safety harness in place	46									
Is safety harness being worn	47									

Compliance	Item	Yes	No	N/A	A	B	C	D	%	Remarks.
7. Personal Protective Equipment.										
All wearing Safety footwear?	48									
All wearing Safety helmets?	49									
Ear protection where appropriate?	50									
Eye protection where appropriate?	51									
Respirators or masks where appropriate?	52									
Protective gloves where appropriate?	53									
Fall arrest equipment where appropriate?	54									
All wearing Hi-Vis vests?	55									

Compliance	Item	Yes	No	N/A	A	B	C	D	%	Remarks.
8. Mobile Elevated Work Platforms.										
Used on level ground?	56									
Guards in position?	57									
Harness clipped on when aloft?	58									
Operators trained?	59									
Current certificates available?	60									

Appendix B

Site Documentation Checklist

Contents of on Site Safety Information Documents.

	1	2	3	4	5	6	7	8	9	10	11
	PSCS Safety Plan	**All Safety Statements M/C & sub contr.**	**Method statements**	**Risk assessment site specific**	**Safety Audits**	**Safety Meetings**	**Safety induction records**	**Training Employees Certs & records**	**Certs for Equip & Machine Tests CR 1-9**	**IR 1 & IR 3 forms**	**Accident log book**
Available											
Yes											
No											
Standard											
Low (L)											
Med (M)											
High (H)											
Access											
Yes											
No.											
		Standard of Documentation etc.									
		Low = **Documentation generic and not site specific.**									
		Medium = **Documentation not generic fair standard**									
		High =**Documentation site specific, well thought out with a lot of effort, revised regularly.**									
Comments											

Appendix C

Interviewee

Template

Interviewee Template

1. Background.

Site No. ______	**Location:**	______________________	Interview 1-5	
Name of Interviewee:		**Mobile:**		
		Office/ Home:		
Interview:	**Start:**	**Finish:**	**Date:**	
Gender:		**Male ▼**	**Female ▼**	
Age:		**Yrs:**		
Company for which you work:				
Type of Company, e.g. Client, M/C PSCS etc.				
Job Title:				
What experience & qualifications did you require to reach this position? How did you reach this position?				
Qualifications:				
Personal Competence in Safety:				
Training received:				
Quality of Training:				
Where:				
When:				
How long:				
Years working in:				

	Construction **Industry**:		
	Your present position:		
	Time working on this site:		

2. Plan of Action?

	Does company have a		
1	Safety Plan (copy	Yes: / No	
2	Risk Assessment (copy	Yes: / No:	
3	Was plan comprised internally or externally?	Internally Externally	
4	Has the plan clear goals & objectives to handle the different hazards on site		
5	Is it a good plan		
6	What procedures does the plan specify to prevent falling from heights because of missing guardrails?		
7	Is the plan of action accessible for managers, supervisors, and workers?		
8	Is the plan improved, revised & updated to meet changes during the time of the project?		
9	Did you have a role developing the plan of action?		

3. Competency of workers and ongoing Training?

1	Induction Training.	
2	On site training.	
3	Does company at the recruitment consider the experience & safety training of Operatives?	
4	Managers & Supervisors etc.	
5	What safety training is done in the company?	
6	Does the company provide ongoing training for Operatives, Managers & Supervisors?	

4. Monitoring System.

What is your role in relation to safety on this site?

1	Accident Reports	Yes	No	
2	Hazard reports	Yes	No	
3	Audits reports	Yes	No	
4	H.S.A reports.	Yes	No	
5	How often are audits carried out?			
6	What areas are covered in audits?			
7	Who conducts audits?			
8	What is your role in safety audits?			
9	Are the audits of any value for improvement?			
10	Is action taken after auditing the workplace?			
11	What is your role in taking action?			

	Hazard Reporting?	
12	What are the formal channels for reporting a hazard?	
13	What happens when a hazard is reported?	
	Accident Reporting?	
14	The formal channels for reporting?	
15	What happens when accident is reported?	
	Incidents/ Near misses?	
16	Do you consider incidents and near misses in your reporting system?	
	Discipline?	
17	When an accident happens or dangerous situation occurs what is the policy of your company?	
18	Is any kind of investigation carried out?	
19	What is the purpose of the investigation?	
20	Are there any disciplinary procedures for employees in breach of safety?	

21	What is your role in this disciplinary process?	
	H.S.A. Inspections?	
22	Has the H.S.A visited your site?	
23	When?	
24	What was the H.S.A. conclusion about safety on this site?	
25	Have any changes been brought about after the visit?	

5. Communication in the Workplace?

.

1	What channels of communication are used when dealing with safety on site?		
✔	**Verbal Communication?**	✔	**Observed Communication?**
	Meetings?		Regular inspection tours?
	One-to-one discussions?		Senior management in meetings?
	Team briefings?		Setting an example?
	Quality circles?		Joint consultation meetings?
	Toolbox talks?		Presentations, workshops, training?
✔	**Written Communication?**	✔	**External Communication?**
	Policy statements?		Reporting accident and ill health?
	Organisation charts?		Dealing with statutory paperwork?
	Performance standards?		Interfacing with H.S.A.?
	Risk assessments?		Interfacing with information services?
	Posters?		Liaison with statutory bodies?
	Newsletters?		
	How effective is the communication used?		
	What is your role in this process?		

6. Responsibility for safety in the workplace?

Sub-contractors are legally required to co-operate with the M/C re safety on site.

1	Who takes responsibility for safety on site?	
2	Does the main contractor take responsibility for safety on site?	
3	Does the PSCS take responsibility for safety on site?	
4	If only some responsibilities are taken which ones are they?	
5	What are your responsibilities for safety on site?	
	Co-Operation?	
6	The level of co-operation between M/C and sub-contractors?	
7	Why is co-operation good or bad?	
8	Are sub-contractors & safety reps. at safety meetings & discussions?	

7. Personal Suggestions to improve safety?

No.	

Changes in H & Safety in the construction industry in the last 5 years?

1. **Has there been any improvement in safety in the construction industry in the last 5 years? (Large building sites) ✓ (Small building sites) Y/N**

1. Large improvement			5. A little worsening		
2. Some improvement			6. Some worsening		
3. A little improvement			7. Large worsening		
4. No change			8. Not sure		

2. **When did improvements start on big building sites?**

3. **Why have safety standards on (big?) building sites improved?**

1	H.S.A site visits?		Insurance?	
2	Regulations?		Ethics?	
3	Prosecutions?		Employee good name	
4	Employee & general awareness of safety.		Other?	

4. Are buildings designs safer to construct?

1. Large improvement		5. A little worsening	
2. Some improvement		6. Some worsening	
3. A little improvement		7. Large worsening	
4. No change		8. Not sure	

5. Acceptance of responsibility for Health & Safety by management?

1. Large improvement		5. A little worsening	
2. Some improvement		6. Some worsening	
3. A little improvement		7. Large worsening	
4. No change		8. Not sure	

6. Degree of worker consultation?

1. Large improvement		5. A little worsening	
2. Some improvement		6. Some worsening	
3. A little improvement		7. Large worsening	
4. No change		8. Not sure	

7. Client influence?

1. Large improvement		5. A little worsening	
2. Some improvement		6. Some worsening	
3. A little improvement		7. Large worsening	
4. No change		8. Not sure	

8. Influence of Training,

1. Large improvement		5. A little worsening	
2. Some improvement		6. Some worsening	
3. A little improvement		7. Large worsening	
4. No change		8. Not sure	

9. Reporting of accidents.

1. Large improvement		5. A little worsening	
2. Some improvement		6. Some worsening	
3. A little improvement		7. Large worsening	
4. No change		8. Not sure	

Appendix D

Site Management

Interview Template

Site Managers' Interview Template

for the Construction Industry

List of seven headings covered:

1. Plan of action
2. Competence of the workforce and ongoing training
3. Monitoring system
4. Communication in the workplace
5. Responsibility for safety in the workplace

SITE No. ______________

Date; _________________

1

Concrete plan of action for dealing with safety related issues	
To look for: ❑ **Safety plan** ❑ **Risk assessment**	This section is aimed to find out if the company has a plan of action to handle safety related issues on the site. Two important documents are necessary (copies should be made, if possible) - the safety plan, and risk assessment for the overall site. If there are more than one safety plans they should also be copied. Nevertheless, keep in mind that having a safety plan or risk assessment is not a guarantee of an active plan of action. So the objective of this section is to investigate how actively those documents are a main reference in handling day to day safety on site.

⇨ Does the company have a safety plan for the site? And a risk assessment?
⇨ Do they represent a clear plan of action to handle with safety?

- Was the plan elaborated internally or externally (example, a consultant)?
- Is this plan of action written elsewhere?

⇨ How is this plan? Has it clear objectives, goals, strategies and actions to handle the different hazards around the site?

- Is it a good plan?
- For example, what procedures does the plan specify to prevent falling from heights because of missing guardrails?

⇨ Is the plan of action accessible as general reference for managers, supervisors and even workers?

- Is the plan of action a paper of reference at safety meetings?
- Is that plan of action improved along the time to better meet safety objectives?

⇨ Did you have any role in developing the plan of action?

Concrete plan of action to handle with safety? **1**	**2**	**3**
NO PLAN OF ACTION Some ideas of how to handle with safety, but not integrated in a comprehensive plan of action	THERE IS A PLAN OF ACTION Mainly, it is a written one, comprehensive, accurate, addressing the problems of the site and available to the workforce	GOOD PLAN OF ACTION Clear plan of action, that is a main reference for the company's safety politics, and actively used and updated to meet company safety goals

2

Competence of the workforce, and ongoing training

To look for:

- ❑ **Induction training**
- ❑ **On-site training**

This section is aimed to find out if the company has any safety criterion for recruitment and training for their workforce. Although possibly rare, written information about what kind of criteria they use for recruitment, and about number, duration, and, if possible, quality of the safety training carried out would be very useful.

⇨ Does the company have any criterion related with safety for:

- Operatives' recruitment (experience, safety training…)
- Subcontractors' selection (past safety records,…)
- Recruitment of managers and supervisors working in safety related jobs

⇨ Does the company set, reward or enforce safety and technical training among the workforce, supervisors and managers?

- How is it done?

⇨ What safety training is done in the company?

- Who is eligible for that training, your own employees, all staff?
- How effective is that training for the pursued goals?
- Which people is responsible for the training process?
- What are the main limitations for carrying out the training program?

The Company is concerned about operatives and subcontractors' competence at the recruitment stage?		
Low Safety backgrounds are rarely considered as an important issue in operatives' recruitment	Medium Safety backgrounds are generally requested but there is no proper system for ensuring it or for keeping records.	High Company checks safety backgrounds at the time of recruitment, & keep safety records of all employees & subcontractors.
The Company is concerned about managers/supervisors' competence at the time of recruitment?		
Low Safety backgrounds are rarely considered as an important issue in operatives' recruitment	Medium Safety backgrounds are considered at time of recruitment but there is no proper system for ensuring it or for keeping records.	High Company checks safety backgrounds at the time of recruitment and look for high level of competence & safety standard history.
The Company provides ongoing training for operatives		
LOW Company training is reduced to an induction programme.	MEDIUM Company training on safety considers more than an induction programme and takes over different times and phases along the site life-cycle.	High Company has an articulated safety training aimed both to an active training on safety and to an active feedback of the effectiveness of the training programme.
The Company provides ongoing training for managers and supervisors		

LOW	MEDIUM	HIGH
Company training is reduced to an induction programme.	Company training on safety considers more than an induction programme and takes over different times and phases along the site life-cycle.	Company has an articulated safety training aimed both to an active training on safety and to an active feedback of the effectiveness of the training programme.

3

Monitoring system To look for: ❑ **Accident reports** ❑ **Hazard reports** ❑ **Audits reports** ❑ **HSA reports**	This section aims to check the quality of the monitoring system. Through this point it should be clear what is understood and monitored as safe/unsafe outcomes, what difficulties the company has in monitoring safety and what is the present description of the company in safety related aspects. Information to look for through documentation aims to look for a register of the trends of safety along the lifecycle of the site, for example in accidents, control of hazards, regularity of safety meetings, and safety audits, etc.

⇨ What monitoring activities are used on site?
⇨ What's your role in monitoring those activities?

Safety Records

- What is recorded as safety related aspects: Personal injuries, structural damage, mechanical damage…
- In what percentage do they happen in site?

Safety Audits (by company)

- How often are audits carry out? What areas each audit cover?
- How are they conducted?
- Who conducts them?
- What is your role in safety audits? What do you audit in each of those areas?

- What have previous audits found about the level of safety of the site?
- What has been the trends of safety along the lifecycle of the site?

- Are those audits of any value for improvement? Is any action taking after auditing the work place?
- What kind of action?
- What is your role in taking action?

Frequency of audits carried out in the company:

Low	*I.* *Medium*	High
Monthly	Weekly	Daily.
Effectiveness of audits to re-direct organisational action:		
LOW Company does not use audits outcomes to re-direct organisational action on safety related aspects.	MEDIUM Company normally considers audits outcomes as stimuli for re-direct some actions, although the main value of those audits is as feedback of the safety level of the organisation.	HIGH Company takes audits as an important source of feedback of the effectiveness of pass actions and as source of information for future needs. Organisational action relies in audit outcomes to improve safety.

Reporting system:

Hazard Reporting

- What are the formal channels for reporting hazards?
- What happens when a hazard is reported?
- Can you describe the trends of hazards along the lifecycle of the site?

Accident Reporting

- What are the formal channels for reporting accidents?
- What happens when a hazard is reported?
- Can you describe the trends of accidents along the lifecycle of the site?

Incident/Near Misses

- Do you consider incidents and near misses in your reporting system?
- What are the formal channels for reporting incidents/near misses?
- What happens when an incident/near miss is reported?
- Can you describe the trends of incidents along the lifecycle of the site?

  ⇨ In your opinion, what is the main cause of accidents and incidents in this site?

Discipline

- When an accident happens or a dangerous situation is discovered, what is the politic of the company? Is any kind of investigation carried out to clarify causes and responsibilities?

- What is your role in this disciplinary process? What can you do? What are your limitations?

HSA Inspections

Yes/No	

- Has any HSA inspector visited your site? When?
- What has been the HSA conclusions about the safety of your site?
- Have any changes been brought about after the visits?

4

Communication in the workplace This section aims to check the quantity and quality of communication about safety in the workplace.

⇨ Is communication on safety a variable of importance for the company?

- If 'yes,' what (safety content) is communicated?
- What goals does the company intend to reach?
- How effectively is the communication used?
- What are the limitations of the present way of communicating?

⇨ What is your role in this process?

⇨ What kind of channels are normally used by the company when dealing with safety related aspects?

• VERBAL COMMUNICATION: ❑ Meetings ❑ One-to-one discussions ❑ Team briefings ❑ Quality circles ❑ Tool box talks	• OBSERVED COMMUNICATION: ❑ Regular inspection tours ❑ Senior management involvement in meetings ❑ Setting an example ❑ Joint consultation meetings ❑ Presentations/training sessions and workshops
(Some)	

• WRITTEN COMMUNICATION: ❑ Policy statements ❑ Organisation charts ❑ Performance standards ❑ Risk assessments ❑ Posters ❑ Newsletters	• EXTERNAL COMMUNICATION ❑ Reporting accident and ill health ❑ Dealing with statutory paperwork ❑ Interfacing with HSE ❑ Interfacing with information services ❑ Liaison with statutory undertakings and bodies

General appreciation of the quality of that communication (it could be reported):		
LOW quality It is mere informative communication without a clear link with safety level	MEDIUM Communication seems to be useful to keep the level of safety in the workplace	HIGH Communication seem to be useful to enhance the level of safety in the workplace

5

Responsibility for safety in the workplace

It is characteristic of this industry to work with a high proportion of workers from sub-contractor companies or even self-employees. Nevertheless, the main contractor is the only legally responsible for safety on the site. Subcontractors are legally required to co-operate with the main contractor to guarantee the safety of the workplace.

This section is aimed to explore in what degree the main contractor has assumed that responsibility, but also the degree and difficulties it can have in relation with co-operation with sub-contractors and employees in general in safety related aspects.

Responsibility for safety

- Does the main contractor take responsibility for [all, some or none of] the safety duties and rights of all staff (for example, safety requirements and equipment are controlled and given by her), or rather it is thought that the safety of the workforce is responsibility of the specific sub-contractors?
- If only some responsibilities are taken, which ones?
- What are your responsibilities for safety issues on site?

Assumption of responsibility by main contractor for the general level of safety in the workplace:

NONE Company tries to delegate her legal responsibility on subcontractors and workers.	SOME Company assumes only some responsibilities for the general safety of the workplace	ALL Company assumes its responsibility for the general safety of the workplace.

Co-operation:

Between main contractor and subcontractors

- What is the level of co-operation between the main contractor and the different sub-contractors to handle safety on site?
- What percentage of subcontractors effectively co-operate with the main contractor?
- Are the different subcontractors and safety representatives taken into account in safety meetings and discussions?
- Is co-operation addressed in the safety plan of the company?
- Are there any difficulties to keep the level of co-operation in site? Which ones?

  ⇨ What's your role in keeping the level of co-operation in site?

Quantity of co-operation between agents in the workplace: What is the level of co-operate with main contractor in respect with safety?		
Low	**Medium**	High
Monthly meetings.	Weekly meetings	Daily meetings.

Appendix E

Explanation of

Site Observational Checklist

and

Recommended Practice

Explanation of Item Numbers and Recommended Safety Practice.

Item no.	Description of item	Recommended Safety Practice
	1. Scaffolding	
1	Scaffolding on sound footing?	Every structure and appliance used as a support for a scaffold shall be of sound construction, have a firm footing or be firmly supported to ensure stability.
2	Base-plates & sole-boards used?	Look for missing baseplates. a] All standards should have baseplates. Minimum requirements for sole plates [boards] On firm ground 500mm long x 225mm x 35mm On soft ground 765mm long x 225mm x 35mm Under 2 standards 1.55m long x 225mm x 35mm
3	Platforms properly supported?	Be stable and of sufficient strength and rigidity for the purpose for which it is intended to be or is being used
4	Scaffolding braced properly?	Bracing is used to make the scaffold rigid and prevent any horizontal movement. The spacing for bracing varies and BS 5973 states that for tube and fitting scaffolds bracings should be fitted every 30m along the scaffold either continuous or dog leg pattern. Kwikstage recommends bracing be fitted so that every 4th bay is a bracing bay. Cuplock recommends every 8th bay be a bracing bay. RMD recommends every 10th bay be a bracing bay. Whatever the system being used the important thing is to remember that bracing should be from as close to the base as possible and be to the full height of the scaffold to be effective and there is a need to avoid changing our pattern from dog leg to heel and toe or similar.
5	Scaffolding tied properly?	Some points to consider for the fitting of ties. 1. they should be as close to the node point as possible and a maximum of 300mm. [A node point is the junction of a standard, ledger and transom, and it is at this point where the scaffold is strongest]. 2. They should wherever possible be fixed to either, both standards or both ledgers, this gives the scaffold added strength

		and prevents sway. 3. Care should be taken if securing a tie to an architectural feature as these are seldom strong enough. 4. Half of the ties should be positive two way ties. 5. Consider which ties are least likely to be removed by following trades, e.g. most through ties will need to be removed to fit windows, an anchor tie will not. 6. All ties should be fixed with right angle couplers only. 7. Make sure that the building is strong enough to support the tie, and the load imposed on it by the scaffold.
6	Ladder access provided?	Where a ladder passes through an opening in the floor of a landing place, the opening shall be as small as is practicable. Ladder access gaps to be no more than 750mm (2.5ft) wide.
7	Platforms fully boarded?	.Look for any working platform which is not fully boarded. 1] Do not include missing 'toeboards' in this question. a] No boards should be missing at all, including inside boards.
8	Handrails in place & mid-rails where necessary?	Every side of any gangway, run or stairs from which a person at work is liable to fall a distance of more than 2.00 metres shall comply with the following requirements – It shall be provided with a suitable guard-rail or guard-rails of adequate strength to a height of not more than 1.20 metres nor less than 950 millimetres above the gangway, run or stairs, except in the case of stairs, it shall be provided with toe-boards or other barriers, up to a sufficient height which shall in no case be less than 150 millimetres and placed so as to prevent, as far as possible, the fall of persons at work, materials or articles, and the space between any toe-boards or barrier and the lowest guard-rail above it shall not exceed 800 millimetres. Item 9. Look for missing guardrails on any working platform. Guardrails should accompany toeboards. Guardrails need to be provided where persons are liable to fall 2 metres (6.5ft) or more. They should be fixed at waist level height (1 m or 3ft high). They should be fixed inside standards. Ladder access gaps to be no more than 750mm (2.5ft) wide.

9	Toe-boards in place?	Toe-boards must be fitted and be at least 150mm high. Any scaffold of 2.0m or more must have toe-boards and guard-rails. Toe boards help prevent materials from falling and they also help prevent persons falling between the guard rail and platform. Toe-boards and end toe-boards should be fixed to all working platforms where a person is liable to fall more than 2 meters. The toe-boards should have a height of at least 150mm above the platform and they should be securely fixed to the standards. In the event that toe-boards and guard-rails cannot be fitted persons working on the scaffold must wear safety harness. Item 8. Look for missing toeboards on any working platform. a] Toeboards should accompany guardrails. b] Toeboards should be 150mm (6") min high - usually a scaffold board. c] Toeboards should be fixed inside the standards with clips.
10	Platforms kept clean?	Look for broken bricks, old mortar boards, used timbers, old paint tins, dried concrete, plastic sacks, etc. a] All scaffold platforms should be cleared off by the various trades.
11	Trap boards	Item 7. Look for scaffold boards not placed correctly on transoms. a] The ends of boards should be placed on transoms, with no more than 150mm (6") overhang, and a minimum of 50mm (2") overhang. b] Bevelled pieces of wood, fitted where necessary to prevent tripping. c] The maximum gap between boards is 25mm (1"). d] Boards should be in good condition, i.e., no splits or warped.
12	Brick-guards in place?	If material is stacked on a scaffold platform above the height of the toe board, proprietary brick guards will be needed to prevent material falling onto other workers or the public below. (Ref. Roofwork COP P46 2nd paragraph 2nd last line.)
13	Trestles used properly?	No trestle scaffold shall be erected on a scaffold platform unless – The width of the said platform is such as to leave sufficient clear space for the transport of materials along the platform, and the trestles or supports are firmly attached to the said platform and adequately braced to prevent displacement.
14	Platforms loads within S.W.L.?	**SCAFFOLD CLASSIFICATION** Scaffolds are classified by type according to their purpose for use. Each scaffold will have set maximum loadings, which in turn will determine the maximum bay centers as follows:

		(scaffold table below)
	2. Ladder access to heights	
15	Proper ladders in use?	Check for ladders that are too short for the job.

Type of Scaffold	Use of Scaffold	Platform loadings		Number of boards & std, crs	Maximum working Platforms	Maximum bay centers	Typical load examples per bay
		KN/m^2	Kg/m^2				
Very light duty Independent	Inspection, Painting, Light Access	0.75	76	3 [0.77m]	1	2.7m	No materials, 1 man + tools
Light duty Independent	Plasterers, Painting, Cleaning	1.5	153	4 [1.0m]	2	2.4m	2 men + 175 kg materials
General purpose Independent	Building work, light brickwork	2.0	204	5 [1.2m]	2 + 1 very light duty	2.1m	1 man + 350 kg materials
Heavy duty Independent	Brickwork, Heavy cladding	2.5	255	5 [1.2m]	2 + 1 very light duty	2.0m	2 men + 250 kg materials
Special or Masonry independent	Masonry work, Concrete, Block work	3.0	306	6 [1.45m]	1 + 1 very light duty	1.8m	2 men + 400 kg materials
Putlog Scaffold	New Brickwork	2.5	255	5 [1.2m]	1	2.0m	1 man + 400 bricks
Light duty Birdcage	Inspection, Painting, Cleaning	0.75	76	Fully Boarded	1	2.5m	No materials 1 man+ tools
Hoist Tower	To encage Hoist	N/A	N/A	Nil	N/A	To suit Hoist	No loading

16	Ladders in good condition?	Item 15. a] Look for any ladder with broken and/or missing rungs as they should not be used.
17	Positioning properly & extend 1m above landing?	a] Look for ladders that extend less than 5 rungs above the landing place.
18	Properly secured?	a] Look for ladders that are not securely fixed with clips or lashed near the top. b] Look for ladders not secured around the stiles. c] Ladders under 3m (10') do not need to be tied/footed.
19	Ladders used safely?	Item 15. a] Look for ladders not on a firm, level base, supported on each stile and prevented from sagging or swaying. b] Look for more than one person on a ladder at anyone time. c] Look for people over-reaching while on ladders. This leads to over balancing, thus, thighs and hips should be kept between the stiles. d] Look for persons re-positioning ladders by 'jumping', while standing on rungs. e] Look for people footing ladders. This is only allowed if they are under 5m (16'6") and cannot be fixed or lashed. f] Look for ladders not at the correct angle - (75 deg) - 1 horizontal to 4 vertical. g] Look for persons carrying materials up a ladder, in sack or other suitable container which does not allow at least one hand on the ladder.
20	Stepladders used safely & fully open?	**1.** Can a mobile scaffold tower or MEWP be used instead? **2.** Check treads, stiles, hinges and restraining rope before using a stepladder. **3.** Damaged stepladder – either destroy or return to supplier. **4.** Use on firm level base. **5.** Don't work higher than two-thirds up stepladder (hand-hold). **6.** Don't lean outwards or sideways from the steps, move them. Ensure steps are fully extended before you go up.
	3. Mobile Scaffolds	
21	All boards in place?	Check that the platform is fully boarded
22	Guardrails fitted properly?	Ensure the platform is fully boarded out and guardrails and toeboards are fitted if working platform is over 2 meters high.
23	Toe boards fitted properly?	Toe-boards must be fitted and be at least 150mm (6") high above the platform. Any scaffold of 2.0m or more must have toe-boards and guard-rails. Toe-boards should be fixed to all working platforms where a person is liable to fall more than 2 meters. The toe-boards should

		have a height of at least 150mm above the platform and they should be securely fixed to the standards. In the event that toe-boards and guard-rails cannot be fitted persons working on the scaffold must wear safety harness. Look for missing toeboards on any working platform. a] Toeboards should accompany guardrails. b] Toeboards should be 150mm (6") min high - usually a scaffold board. c] Toeboards should be fixed inside the standards with clips.
24	Safe means of access?	Never climb up the outside of a tower – use the stairway or ladder on the inside.
25	Ground firm & level?	Towers must only be used on firm surfaces. Where the ground is soft, adequate support must be provided. Ensure the tower is vertical and square.) Mobile scaffolds be used only on a firm and even surface not so sloping as to involve risk of instability of the scaffold or any load thereon,
26	Tower tied to building if unattended?	Tie the tower to a permanent structure where possible. Check that tower is tied if unattended
27	Wheels locked?	Towers must not be used unless the wheels are locked.
28	Base height ratio O.K. e.g. (1-3)?	Base height ratio. Follow manufacturer's instructions on base to height ratio.
29	Clear of people & material when being moved?	Check that tower is not moved if persons or materials are still on the platform. Check that tower is not pulled along while standing on it.
30	Scaffold used safely	Check that the manufacturer's SWL for the tower is not exceeded. When working, ensure access hatch is closed on platform.
	4. Workplace access	
31	Clear Access routes?	Look for rubbish/debris on all areas of the site, including all floor levels. a] Walkways, access routes and staircases should be free from rubbish/debris?
32	Safe footing?	Look for rubbish, debris, materials, trip hazards, timber or materials with protruding nails on all areas of the site that is a source of danger to persons on site.

33	Adequate width?	Ensure that the floor area at a workstation on a site allows persons sufficient movement to perform their work
34	Route signage?	Check that vehicle, goods and pedestrian traffic routes are signposted as the type of construction activity requires
35	Floor edges / openings / voids protected?	Look for any opening that is left uncovered/unguarded. a] Openings on the floor should be covered with 25mm plywood or have a guardrail around it. b] Openings in walls should be guard-railed off if below waist height (external) or where there is a drop next to it (internal).
36	Manholes / access opens protected?	Look for any opening that is left uncovered/unguarded. a] Openings on the floor should be covered with 25mm plywood or have a guardrail around it. b] Openings in walls should be guard-railed off if below waist height (external) or where there is a drop next to it (internal).
	5. Housekeeping	
37	Scaffold base free of rubbish	Look for broken bricks, old mortar boards, used timbers, old paint tins, dried concrete, plastic sacks, etc. a] All scaffold platforms should be cleared off by the various trades.
38	Scaffold lifts free of rubbish	Look for broken bricks, old mortar boards, used timbers, old paint tins, dried concrete, plastic sacks, etc. a] All scaffold platforms should be cleared off by the various trades.
39	Materials stored neatly & safely	a] Look for brick pallets that are stacked higher than two. b] Look for timbers that are not stacked or stored neatly on 'bites'. c] Look for steel(s) that are not stacked neatly on 'bites'. d] Look for scaffold materials that are not stacked neatly. e] Look for materials that are stacked more than 2m (6.5ft) or a man's height. f] Look for materials that are stored next to open trenches or excavations. g] Look to make sure 'access' gaps are provided between stacks of materials. h] Look for overhanging materials obstructing access routes. i] Look for stacks that are unstable and/or overhanging
40	All access routes & stairways rubbish free	Look for rubbish/debris on all areas of the site, including all floor levels. a] Walkways, access routes and staircases should be free from rubbish/debris?
	6. Roof work	
41	Warning notice on approach to fragile roof?	A suitable warning notice "danger fragile roof" shall be affixed at the approach to fragile roof work

42	Are crawling boards in place?	"sloping roof" means a roof or part of a roof being a roof or part having a pitch of more than 10 degrees which is covered either wholly or partly. Where a sloping roof is used as a means of access to or egress from work on a roof or a part of a roof being worked on, sufficient and suitable crawling ladders or crawling boards shall be provided on that sloping roof.
43	Edge protection in place?	A suitable barrier shall be provided of such a design and so constructed as to prevent any person at work falling from that edge at the lower edge of the sloping roof which a person at work could fall a distance of more than 2.00 metres, Suitable and sufficient means shall be provided to prevent the fall of materials or articles from a sloping roof.
44	Guardrails in place?	Same as (8 & 22)
45	Toe boards in place?	Same as (9 & 23)
46	Anchorage points for safety harness in place	Safety harnesses or safety belts attached continuously to a suitable and securely fixed anchorage,
47	Is safety harness being worn	Where by virtue of paragraph (1) safety nets or safety sheets would be required to be provided for the protection of persons at work but all such person are able safely to carry on the relevant work or use the relevant access or egress by making use of safety harnesses or safety belts attached continuously to a suitable and securely fixed anchorage,
	7. Personal Protective Equipment	
48	All wearing Safety footwear?	Look for anybody on site not wearing footwear?
49	All wearing Safety helmets?	Look for anybody on site not wearing safety helmet. Exception site huts and canteen
50	Ear protection where appropriate?	Look for any person not wearing ear defenders while using noisy equipment. As a general, if machine or equipment is so noisy that operatives have to shout to carry out a conversation, ear defenders are required.
51	Eye protection where appropriate?	Look out for employees using abrasive wheels, cutting equipment and cartridge operated tools require some form of eye protection, either goggles, face shields or visors.
52	Respirators or masks where appropriate?	Look for operatives not wearing face masks while working in dusty conditions.
53	Protective gloves where appropriate?	1993 Regs. Gloves to provide protection: - from machinery (piercing, cuts, vibrations, etc.), - from chemicals. - for electricians and from heat. - Mittens. - Finger stalls. - Oversleeves. - Wrist protection for heavy work. - Fingerless gloves.
54	Fall arrest equipment	**Training Guide – California** if there are no guardrails, you should tie off: When working on **any structure** at a height over 2 meters, if you might fall: from the perimeter, through elevator shafts, other shaftways, or openings from steep sloped surfaces.

	where appropriate?	When working from **thrustouts, trusses, beams, purlins,** and **plates.** When working on **skeleton steel** of a multistory structure. When working on a **steep roof** (1/3 pitch or steeper) while using pneumatic tools. When working from a **boatswain chair, floating scaffold**, **needle-beam scaffold** or **suspended scaffold**.
55	All wearing Hi Viz Vests	The exception is in the site huts.
	8. Mobile Elevated Work Platforms.	
56	Used on level ground?	MEWP's must be used on level ground
57	Guards in position?	Guards in position?
58	Harness clipped on when aloft?	Harness to be attached to secure anchorage point within the platform.
59	Operators trained?	Operators should be trained in the types of MEWP for which they operate.
60	Current certificates available?	Current certificates should be available for the types of MEWPs they operate.

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