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Analysis of Scaffolding and Ladder Incidents Offshore

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HEALTH & SAFETY LABORATORY

OSD Incident Analysis for OSD Data Intelligence Section

RAS/99/10

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HEALTH AND SAFETY LABORATORY
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Analysis of Scaffolding and Ladder Incidents Offshore

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Summary

Objectives

This report describes the incident analysis work on offshore incidents completed to date by HSL for OSD's Data Intelligence Section. The aim of the work was the analysis of incidents from various categories of offshore work using information provided by OSD's Data Intelligence Section from their offshore incident database . This report contains two analyses: one covering incidents involving scaffolding and the other incidents involving ladders.

The objective of the first analysis (the scaffold incidents) was to analyse the data provided from the database, to draw conclusions and to make recommendations. The objective of the second analysis was to categorise the data according an incident categorisation method used by FOD, recommendations were not required in this second analysis.

Main Findings

The analysis of the scaffolding incidents revealed that most of the incident types came within the falling objects, slips trips and falls, or the handling categories. The activities most responsible for leading to these incidents were erecting/dismantling and manual handling/lifting. A large number of the incidents involving scaffolding were linked to the use of hand tools or other equipment.

The analysis on the ladder related incidents revealed that the most commonly reported incident, by a long way, was the user falling. The ladder slipping and impact were the next largest contributors, ladder failure was the smallest contributor.

Main Recommendations

In order to reduce the number of scaffolding related incidents on offshore installations there are several areas which this report highlights as being particularly important, these include:

- Improved housekeeping in order to reduce the number of slips, trips and falls, falling object and hit object incidents.
- Review of the procedures for erecting/dismantling scaffolding and giving more guidance and training on manual handling techniques.
- Additional training in the use of particular tools and equipment with specific emphasis on working at height.

Contents

1. INTRODUCTION

This report combines two analyses of incident data which were performed for OSD's Data Intelligence Section by HSL. The first analysis covers offshore incidents involving scaffolding and the second covers offshore incidents involving ladders. The data for the analyses was provided by OSD and had been obtained from their 'Offshore Incident Database'.

The Offshore Incident Database contains details of incidents which have been reported to HSE under various legislation, depending on when the incident was reported. For those incidents reported before 1995 the incidents were reported under one of the following:

- Mineral Workings (Offshore installations) Act 1971
- Offshore installation (Inspectors and Casualties) Regulations 1973: SI 1973 No. 1842
- Submarine Pipelines (Inspectors and Casualties) Regulations 1977: SI 1977 No. 835

Incidents which occurred post-1995 were reported under the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995.

The data intelligence section within OSD are responsible for the collection of data regarding offshore incidents. In order to prioritise risk reduction to personnel offshore it is necessary to analyse this incident data to identify trends and patterns. HSL were commissioned by the Data Intelligence Section to assist them with this function.

Search results from the offshore incident database were supplied to HSL by the Data Intelligence Section for each analysis. These records contained details about the incidents including the incident time and date, a short and full description of the incident, incident type, activity leading to the incident and severity of the incident. The data was analysed according to the specific requirements of the Data Intelligence Section for the specific analysis.

This report describesthe two analyses completed so far, the first analysis is concerned with scaffolding related incidents and the second with ladder related incidents.

2.0 OSD SCAFFOLDING INCIDENTS

A sample of 79[1] scaffolding incidents were supplied to HSL from the HSE OSD offshore accident database (these were in the form of spreadsheet files). Of these, 27 were dangerous occurrences and 52 were accidents. The incidents cover the periods:

- January 1991 to March 1995 (all records)
- April 1995 to 1997 (partial records from the temporary database set up to allow modifications to the main system)

All of the incidents relate directly to scaffolding in some way. The events were selected by OSD from the database by searching both the short text and the full description of each incident for the keyword scaffold. This way all entries beginning with the text 'scaffold' would be found (e.g. scaffolding, scaffolder etc.).

Figure 2.1 shows the number of incidents by year. There is a fall in the number of incidents from 1991 to 1992 before rising again in 1993 and remaining at this level for the next two years. There is also a fall off from 1995 to 1996 which is probably due to the incomplete data set. There are several reasons why the incident rate might vary, for example industry guidance was issued in October 1995, and the Cullen Report was published in 1990.

Therefore a statistical test was carried out to see if the variation by year is in fact significant. A chi-squared test of confidence was carried out for 1991 to 1995 data inclusive. It was found that the variation is not significant at the 5% level[2], i.e. there is no statistically significant effect due to the year.

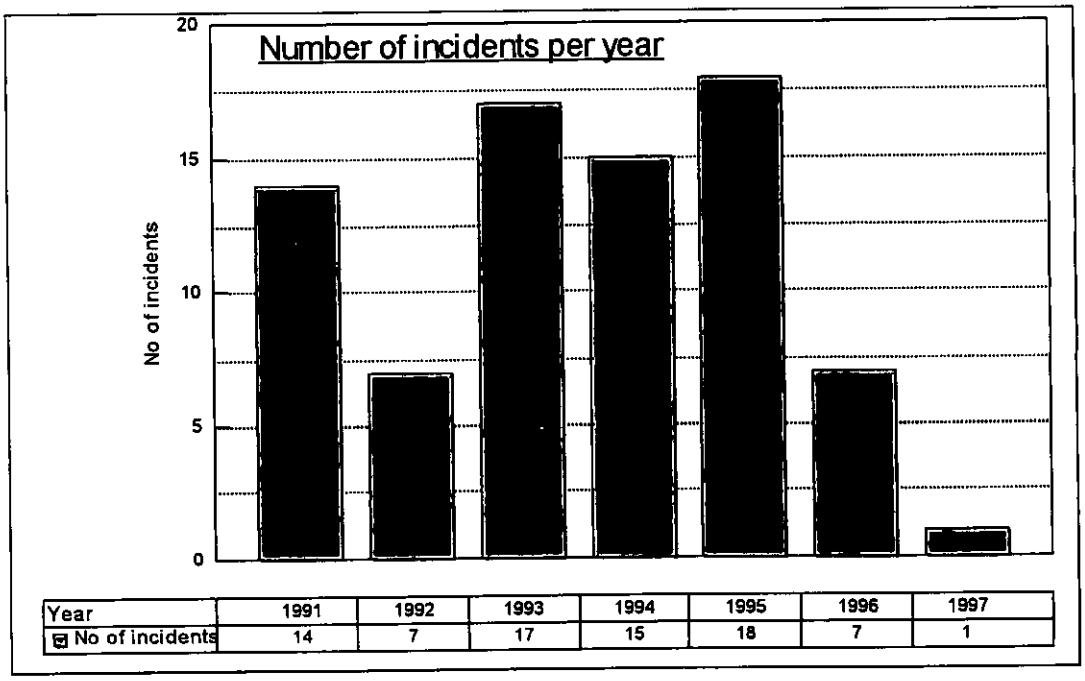

Figure 2.1 - Number of incidents reported on a yearly basis

1 80 incident descriptions were supplied, however 2 were identical in every aspect other than the dates (which were 9 days apart). These were assumed to refer to the same incident.

2 Chi-squared = 5.27, degrees of freedom = 4, probability = 0.26

It is also possible that there may be some seasonal variation in the incident rate. For example, the harsher climate during the winter months may have an effect. This was studied by splitting the year into two 6 month periods: the first April to September, (representing the summer months) and the second October to March (representing the winter months). The result was an almost even split with 49.4% of the incidents occurring in the winter periods, and 50.6% in the summer periods. This indicates that there is no observed association between incident rate and time of year.

All of the incidents were categorised according to the severity[1] as follows;

1. Fatality
2. Serious injury
3. >3 day injury
4. Dangerous occurrence

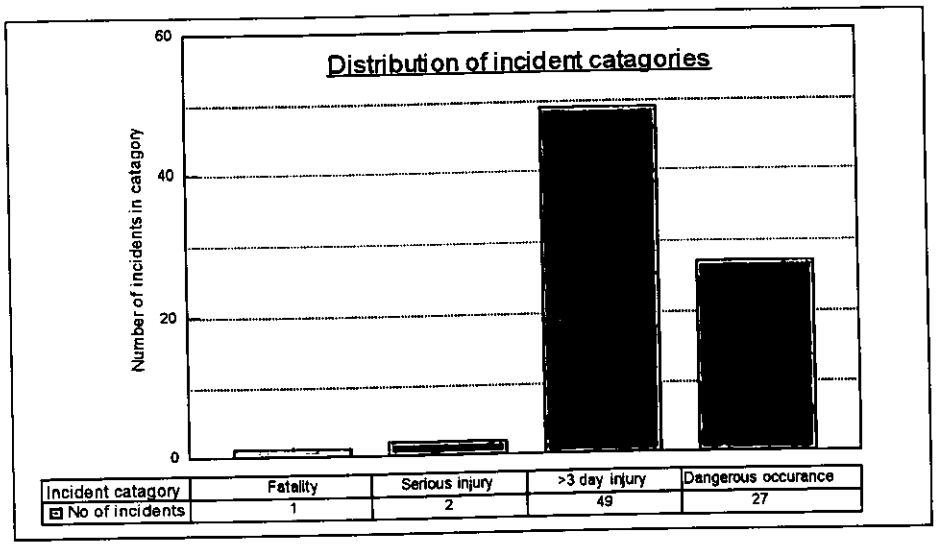

Figure 2.2 - Incident severity

The number of incidents in each category is indicated in Figure 2.2. This shows that most of the reported incidents (62%) resulted in over 3 day injuries.

It is interesting to compare these results with those given in HSE's 'The Cost of Accidents at Work' (1997) for the case-study on a North Sea oil production platform. This study suggests that over 3 day injury accidents, minor injuries and non-injury accidents occur in the ratio 1:4:126. This implies that for every incident resulting in a >3 day injury or worse there would be 126 non-injury accidents.

Therefore for the 52 over 3 day injuries or worse we would expect there to have been approximately 6,000 non-injury accidents and approximately 200 minor injuries. While non-injury accidents (as defined in 'The Cost of Accidents at Work') are not defined in the same way as dangerous occurrences (as defined in HSE's 'Notice of casualty or other accident involving loss of life or danger to life, on or near, to an offshore installation') there is some overlap. Against this background, the reporting of only 27 dangerous occurrences may suggest some under-reporting.

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1 For full definition of the severity categories see note (a) of 'Notice of casualty or other accident involving loss of life or danger to life on or near an offshore installation'.

Under reporting is a possible issue for many areas of HSE's work; underlying causes can include problems with safety management systems.

Figure 2.3 shows the incidents broken down into 'Broad Incident Type'; i.e. it shows the type of incidents which led to the particular injury/illness and the number falling into each category. In order to reduce the number of incidents in the 'other' category, a new incident type; 'hit stationary object' has been used based on information supplied in the text. This new category is used to describe such events as hitting head on fixed plant and backing into an object. More incidents are assigned to this new category than to some of the existing categories.

The most common incident type was 'falling object' which accounted for 28% (22) of all incidents, however this is not spread uniformly over dangerous occurrences and accidents: falling objects account for 56% of dangerous occurrences compared to only 15% of accidents. The second largest group is the 'slips/trips/falls' group at 22.8% (18), with the next largest contributors being 'handling of goods/materials' and 'other' each making up 12.7% (10) of the incidents.

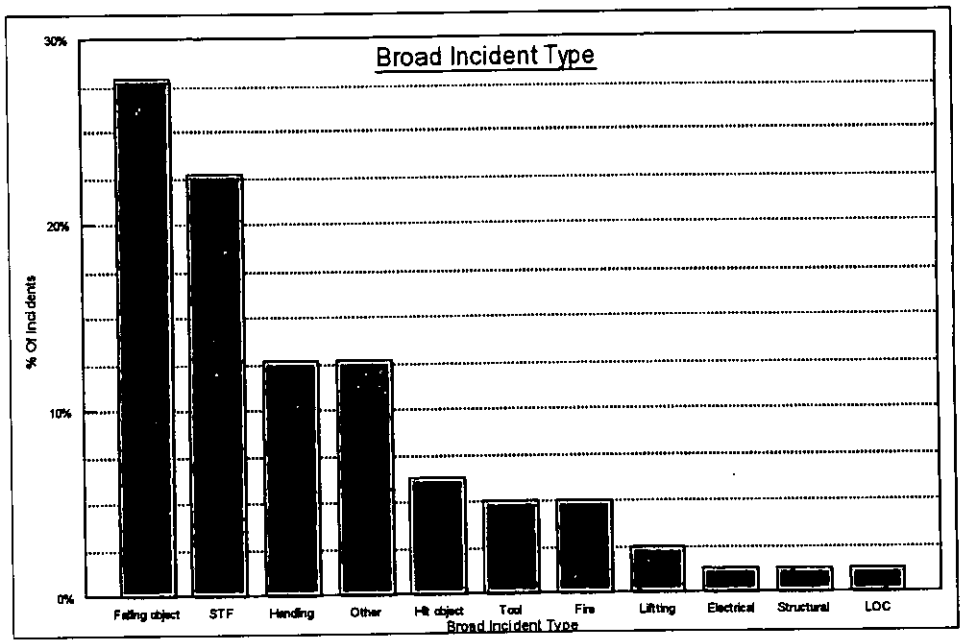

Figure 2.3 - Incident types

Key to Broad Incident Types		No.
Falling Object	Falling Object	22
STF	Slips/trips/falls	18
Handling	Handling goods/materials	10
Other	Other	10
Hit object	Hit stationary object	5
Tool	Use of hand tool	4
Fire	Fire/explosion	4
Lifting	Lifting/crane operations	2
Electrical	Electrical	1
Structural	Structural/foundation	1
LOC	Loss of containment	1
Machinery	Operating plant/machinery	1

Figure 2.4 shows the activities leading to the incidents and the percentage of cases falling into each category. Note that this is the actual activity leading to the incident and is not necessarily the activity being carried out by the injured person. It can be seen that erecting/dismantling scaffolding was the activity that lead to the most incidents (43.0%) , other large contributors were manual lifting/handling (17.7%), other (11.4%) and climbing/descending (8.9%).

It is interesting to note that there is a relatively high value for lifting as the activity leading to the incident (17.7%), and for handling goods/materials as the incident type (12.7%).

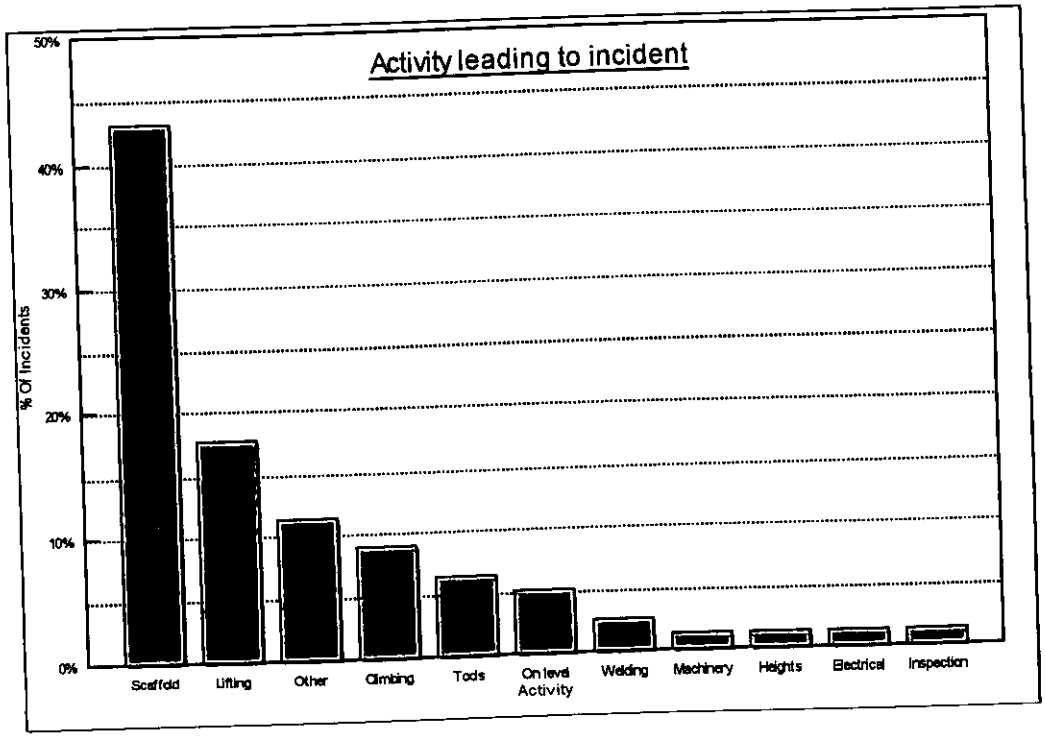

Figure 2.4 - Activity leading to incident

Key to Activity Types		No.
Scaffold	Erecting/dismantling scaffolding	34
Lifting	Manual lifting/handling	14
Other	Other	9
Climbing	Climbing/descending	7
Tools	Using portable tools/equipment	5
On level	Walking on same level	4
Welding	Welding/burning	2
Machinery	Operating plant/machinery	1
Heights	Working at a height (>2m)	1
Electrical	Electrical work	1
Inspection	Inspection/examination	1

Figures 2.5 to 2.7 are 3 dimensional bar charts and show the number of incidents in a way which allows the trends between the incident classification groups to be seen.

Figure 2.5 shows the link between the 'activity' being carried out and the severity of the incident. This shows that the activity which leads to the most dangerous occurrences, > 3 day occurrences, and the only fatality, is erecting/dismantling scaffold.

Figure 2.6 shows the relationship between the 'broad incident type' and the severity of the incident. It shows that most of the incidents are '> 3 day injuries', this is followed by 'dangerous occurrences'. The most prominent cause of dangerous occurrences is falling objects whilst most prominent cause of greater than 3 day injuries are slips, trips and falls.

Figure 2.7 shows the relationship between the activity leading to the incident and the broad incident type. The activity erecting/dismantling scaffolding is responsible for most of the falling object incidents and most of the slips, trips, and falls incidents. Whilst (not surprisingly) most of the handling goods/materials accident types are caused by manual lifting/handling.

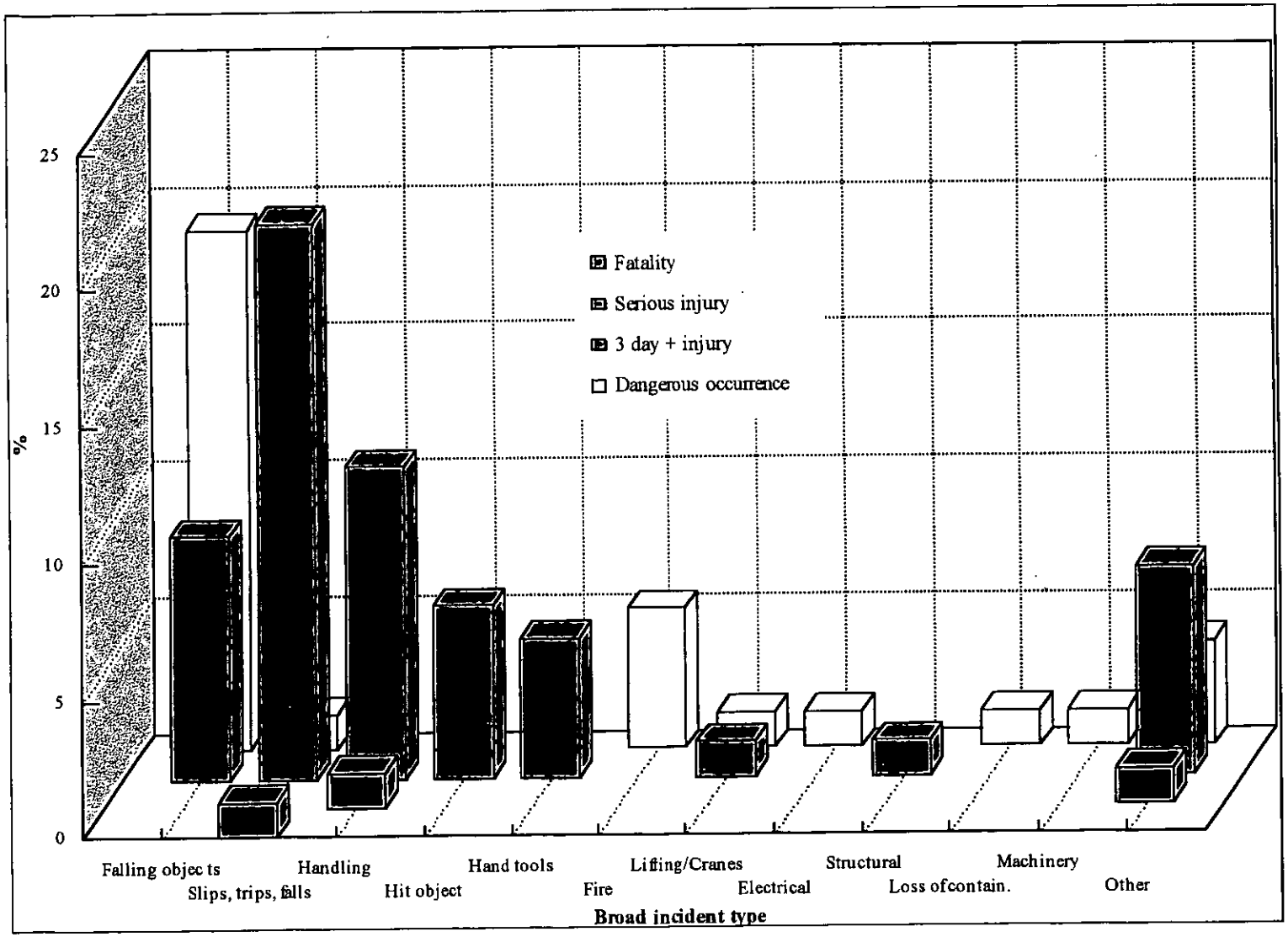

Figure 2.5 - Relationship between incident type and severity

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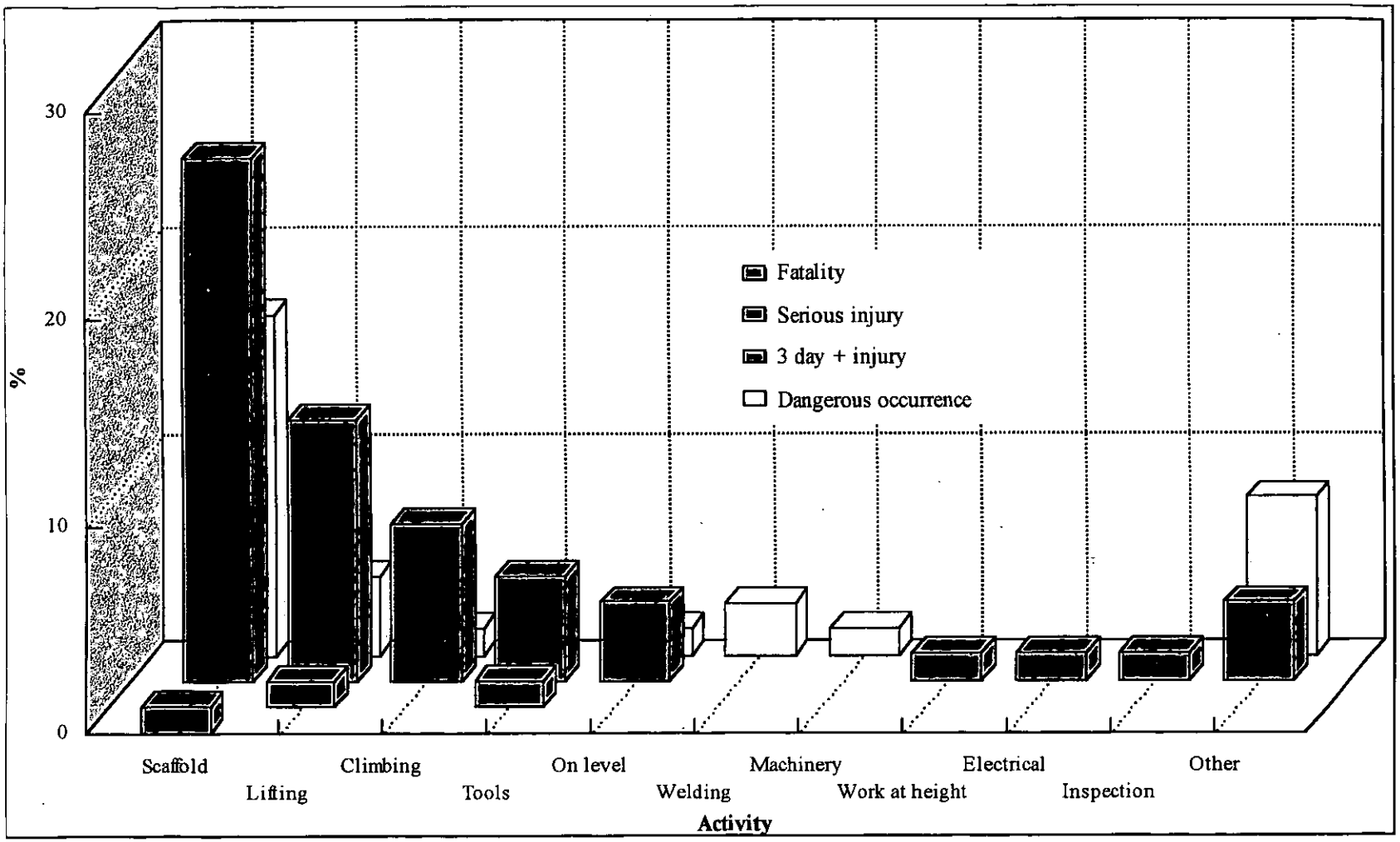

Figure 2.6 - Relationship between activity and incident severity

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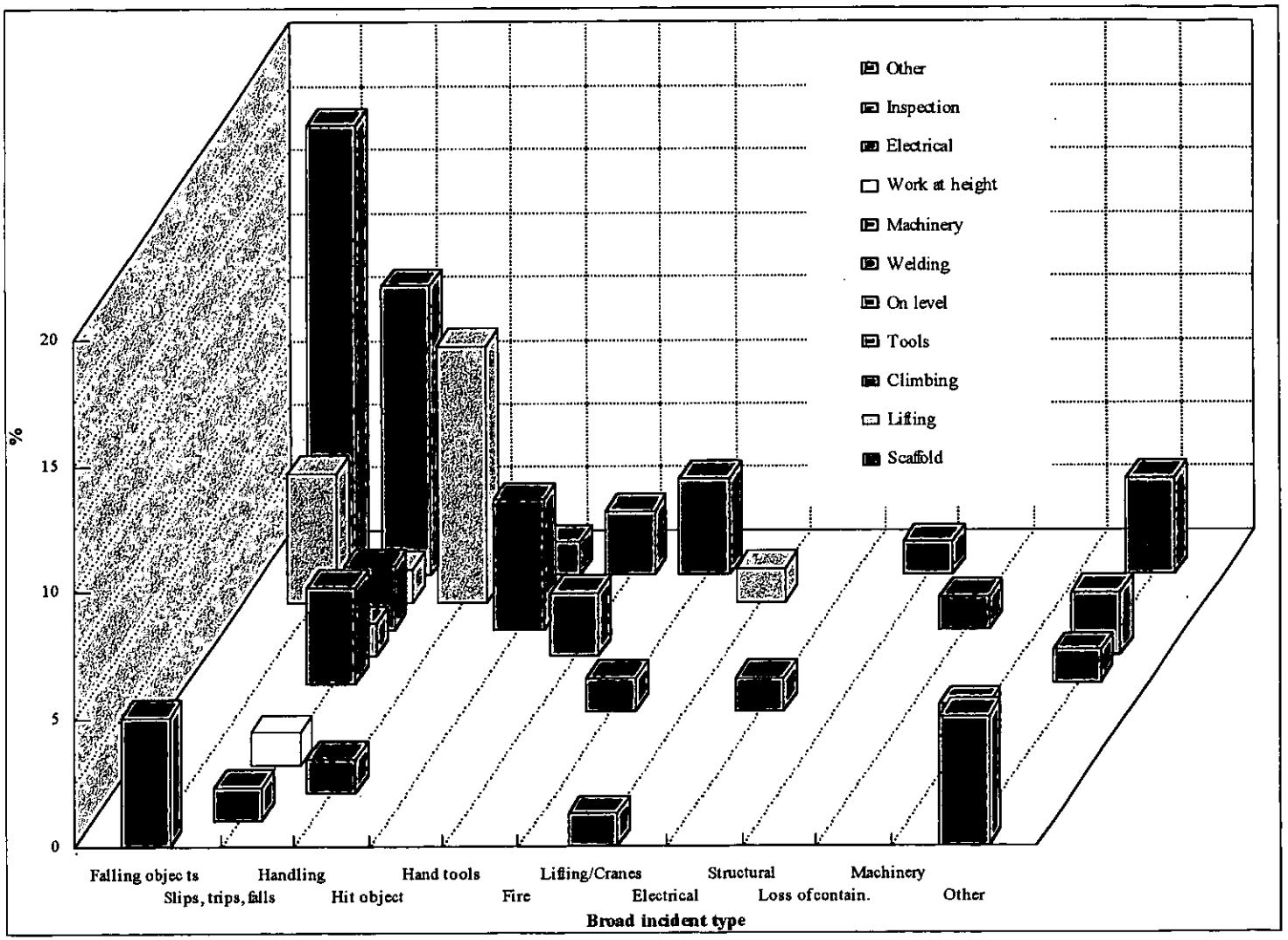

Figure 2.7 - Relationship between activity and incident type

Contents

In addition to the information considered above, an analysis was made of the textual information in the incident records. Based on the text, the incidents were assigned to the new categories described below. These new categories are specific to the scaffolding incidents - as opposed to the more general incident types from the reporting form. Figure 2.8 shows the distribution of accidents over these new categories.

Note that the text print supplied by OSD contained 80 incidents i.e. one more incident than in the spreadsheet files (the additional record is OIRA 112208, 28/9/97).

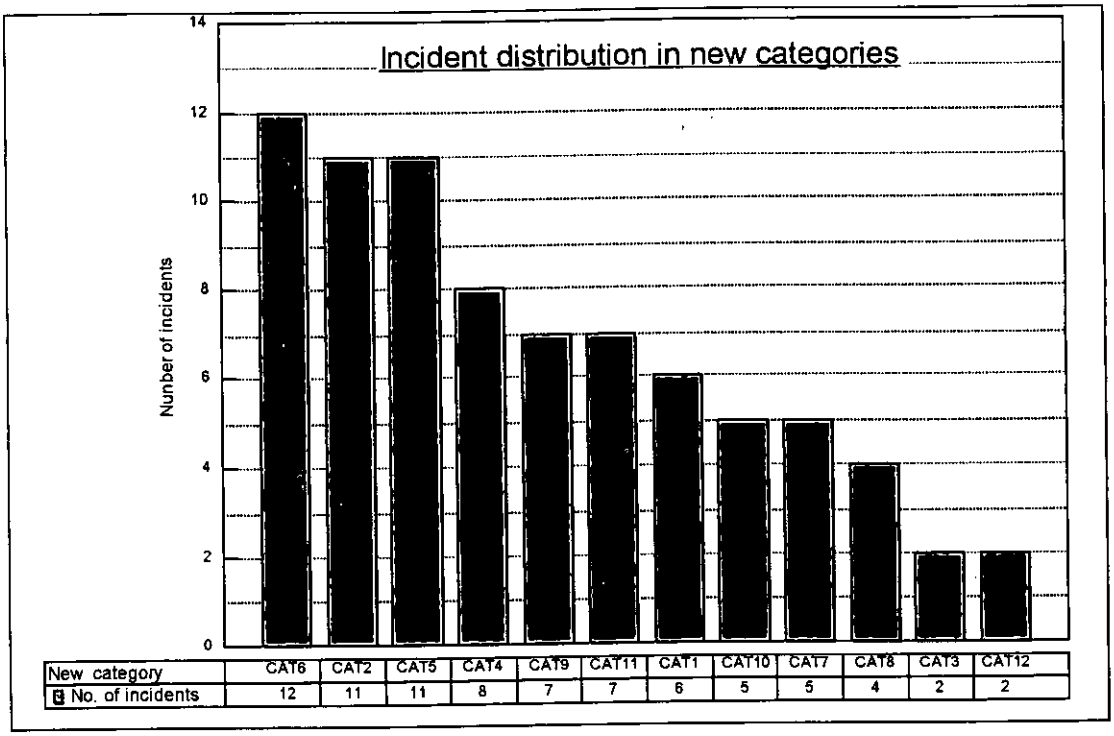

Figure 2.8 - distribution of incidents in their new categories

Key to new incident categories

CAT1	Scaffolding dropped during erection/dismantling
CAT2	Falling scaffolding (not dropped)
CAT3	Falling object other than scaffolding
CAT4	Use of handtool/other equipment
CAT5	Slips, trips and falls on the same level
CAT6	Lifting or manual handing
CAT7	Falls during erection/dismantling
CAT8	Falls from completed scaffolding
CAT9	Scaffolding collapse
CAT10	Fire, electrical or welding
CAT11	Walk into scaffolding or other equipment
CAT12	Other

The first category (CAT1) represents those incidents in which a piece of scaffolding was dropped or mishandled such that it fell; a 'piece of scaffolding ' refers to the scaffold poles and the walkway boards. The second category (CAT2) is also concerned with pieces of scaffolding falling but in this group the scaffolding is not dropped, most common events in this group are poles rolling from where they are rested. The third category (CAT3), is concerned with falling objects (whether dropped or otherwise), that can not be described as scaffolding.

CAT4 is used to group all incidents which occurred due to the use of a hand tool or other piece of equipment. CAT5 is slips, trips and falls and includes any cases of mis-footing, this category is used when there is no evidence to suggest that the fall was from a height, (i.e. it is a fall on the same level). The 6th category covers all incidents which were caused by lifting or manual handling.

The 7th and 8th categories are similar but differ in that CAT8 only has falls from scaffolding which occur during either erection or dismantling of the scaffolding, and CAT7 includes falls from either complete scaffolding or from ladders.

CAT9 is scaffolding collapse, this category includes collapse due to extreme wind (about half of these cases are due to wind). The tenth category combines all incidents caused by either fire, welding or electrical hazards. Incidents such as walking into scaffolding or other equipment is put into CAT11, whilst any other incidents which can not easily be put into one of the above categories are put into CAT12.

As Figure 2.8 shows most of the incidents (97.5%) have been placed in the new categories, without resorting to classifying them in the 'other' category (these were; (i) the bending of a scaffolding pole during a turret turning operation and (ii) a crane signaller who hurt his knee when turning). The three major contributors (together accounting for 42.6% of the incidents) are 'lifting or manual handling', 'falling scaffolding (not dropped)', and 'slips, trips and falls'. This reinforces the findings shown in figure 2.3, where it was the same three incident types which were dominant (although in a different order). The next largest category is use of handtools or other equipment, where in most cases the fact that scaffolding is involved is irrelevant to the incident cause (however in some cases this does tend to make the consequence of the event more serious).

2.1 Conclusions from scaffolding analysis

Based on the 79 incidents it is found that:

- Although there is some variation in incident rate from year to year, this variation is not statistically significant.
- Seasonal effects (summer/winter) are not correlated with the number of incidents.
- More accidents were reported than dangerous occurrences. This may suggest some under-reporting of dangerous occurrences.
- Most of the incidents types are classified as either falling object, slips, trips and falls and handling.
- The activities most responsible for leading to incidents are erecting/dismantling scaffolding and manual handling/lifting.

From the more detailed study of the events including their re-categorisation several points were found;

- The category containing the most incidents was lifting/manual handling
- A large number were linked to the use of handtools or other equipment, a lot of these incidents would have occurred whether on scaffolding or not, the scaffolding is therefore not a contributor to the incident but in many cases it effects the result of the incident
- Falling scaffolding (not dropped) is often caused by pieces of scaffolding being left temporarily in an unsuitable position or place or stacked in a hazardous manner

2.2 Recommendations for scaffolding incidents

In order to reduce the number of scaffolding related incidents on offshore installations, areas on which attention could be focused include:

- Erecting/dismantling and manual handling/lifting because these are the activities most responsible for leading to incidents. In particular the procedures for the erecting and dismantling of scaffolding could be reconsidered with a view to improvement, as this activity leads to almost half of the incidents studied.
- Falling objects, slips, trips and falls, and handling because these are the predominant incident types.
- Whether there is a need for further training and guidelines to help individuals assess manual handling tasks effectively, and use safer lifting techniques. The high number of incidents within the 'slips/trips/falls', 'falling objects' and 'hit object' categories suggests that improved housekeeping may reduce the number of incidents.
- Training in the use of particular tools and equipment may help to reduce the number of incidents which involve their use.

- Falling scaffolding is often caused by it being left 'temporarily' in an unsuitable position or place, improvements in house-keeping along with providing adequate permanent and temporary storage facilities for the scaffolding may help to reduce this problem.

3.0 OSD LADDER INCIDENT ANALYSIS

3.1 INTRODUCTION

OSD is carrying out an analysis of ladder accidents. A similar analysis is being done by FOD (as the first part of a campaign on ladder safety), and it is intended that by using identical categories for the 2 analyses, comparisons can be made between onshore and offshore accidents. A set of 242 incidents involving the use of ladders was supplied to HSL by OSD, to carry out this analysis. The incidents cover the period January 1991 to January 1998.

From the incident texts supplied, a large proportion involved fixed ladders, which had not been considered in the FOD study of onshore ladder incidents. However, as fixed ladders are widely used on offshore installations, it was necessary to include them in this analysis.

3.2 ANALYSIS

3.2.1 Removal Of Non-Ladder Incidents

The analysis began with the removal of any cases which were not relevant. For example, there were some incidents which did not to involve ladders (e.g....Due to the bladder being damaged...). In addition there were incidents which were not ladder-related incidents, despite containing the keyword 'ladder': these included 'manual handling' (e.g....carrying a can of paint onto a scaffold using an access ladder. He sustained a muscular strain in his side or shoulder area when he lifted the paint can...) and 'falling object' incidents. However if the falling object caused the injured party (IP) to fall from the ladder, the incident is categorised as a ladder accident.

There were a large group of incidents in which the IP slipped, tripped or fell as they were getting onto or off the ladder (either at the top or bottom). Some of these cases were clearly not ladder incidents (e.g. '...IP descended ladder onto main walkway, put foot on scaffold clip on deck and ankle went over.') and may have occurred regardless of the ladder. Judgement was used to assess which of these incidents were ladder-related.

After removal of the non relevant cases the sample size was reduced to 120 (from 242), which is 49.6% of the total.

3.2.2 Type Of Ladder

Firstly the incidents were categorised according the type of ladder. In 32.5% of cases, the type of ladder could not be defined from the text. When trying to ascertain the type of ladder judgement had to be made: for example, for a description such as '...the IP descended ladder from a module onto the working platform...', the ladder was assumed to be fixed, as offshore platforms have many fixed ladders leading to modules. All hooped ladders were considered to be fixed. Table 3.1 shows the number of incidents attributed to the various ladder types. It is interesting to note that bunk ladders account for nearly 11% of the incidents.

Table 3.1 - All ladder types

Ladder type	Number	%
Fixed ladder	20	16.7
Ordinary ladder	9	7.5
Step ladder	6	5
Crane ladder	5	4.2
Bunk ladder	13	10.8
Unknown	39	32.5
Scaffolding ladder	24	20
Extension ladder	1	0.8
Tubing frame ladder	1	0.8
Wood ladder	1	0.8
Portable ladder	1	0.8
TOTAL	120	

To simplify this information, the incidents were categorised into 3 general ladder types: (i) fixed, (ii) unfixed, (iii) unknown. It was assumed that all bunk bed ladders and crane ladders would be fixed and so these were all combined into a single 'fixed ladder' category. It was also assumed that portable, wood, extension, tubing frame, step, scaffolding, and ordinary ladders were all unfixed (unless otherwise specified) and these were combined into a category for unfixed ladders. The distribution by general ladder groups is shown in Table 3.2 below and is shown graphically in Figure 3.1.

Table 3.2 - General ladder types

Ladder type	Number	%
Fixed	38	31.7%
Unfixed	43	35.8%
Unknown	39	32.5%

Figure 3.1 - General ladder types

3.3 Analysis Using FOD Ladder Categorisation

Table 3.3 shows the ladder categorisation used in FOD's onshore analysis. The incidents were analysed according to these categories. In most cases, the information required for a full comprehensive analysis was not present and therefore there are a lot of 'Not Known' (N/K) factors. For the same reason, only a small proportion of the cases contain enough information for any 'significant other causal factors' to be identified.

Firstly, the incidents were categorised according to the 5 'Accident Cause' categories (that is the causes A - E in bold type in Table 3.3. The results are shown in table 3.4 and figure 3.2.

Table 3.4 - Primary accident cause

Cause	Number of accidents	%
A - Ladder slips	14	11.6%
B - User falls	95	79.2%
C - Failure of support	0	0%
D - Impact	10	8.3%
E - Ladder failure	1	0.8%

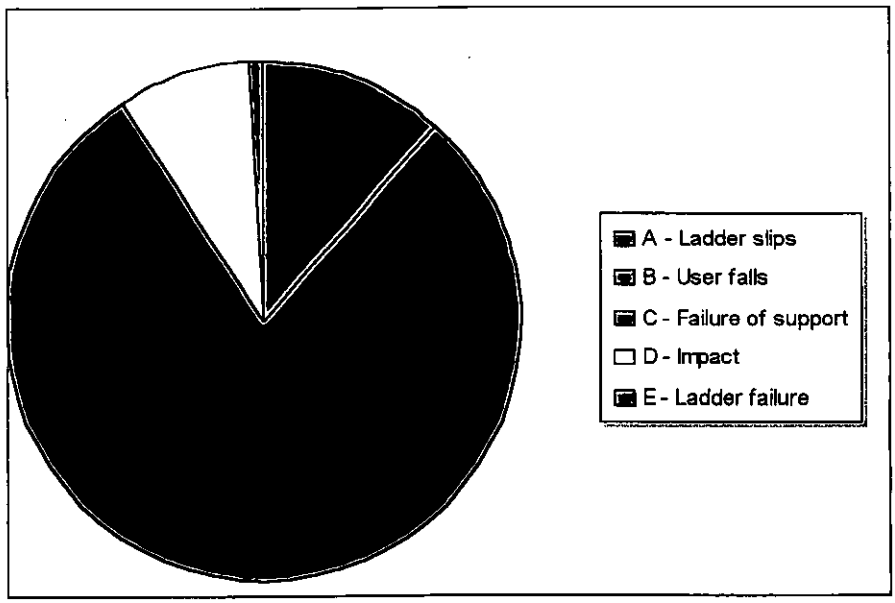

Figure 3.2 - Primary accident cause

Secondly, a more detailed look at the incidents provided information on: the accident cause subsets (the small case letters from Table 3.3), the cause of failure (as outlined in Table 3.3), and in a few instances other causal factors (additional significant factors which can be deduced from the incident descriptions). A summary of this information is given in the tables (3.5 to 3.9).

Table 3.3 - Incident categorisation table (as used in FOD's analysis)

Accident cause (i.e. what moved)	**Cause of failure** (i.e. why did it move)	**Significant other causal factors**
A - Ladder slips a)slips sideways b)slips outwards c)twists d)parallel movement e)other f)N/K	i)ladder not secured ii)inadequate securing iii)failure of securing device iv)other v)N/K	**10 Ladder** 11 suitability 12 condition 13 positioning 14 securing 15 'footing' 16 correct angle 20 User 21 condition/health 22 training/health 23 footwear/clothing **30 Support for ladder** 31 suitability 32 condition **40 Environment** 41 suitability **50 The job** 51 suitability 52 Equipment/materials 53 access **60 Management** 61 employee selection/training 62 job selection 63 equipment selection 64 maintenance procedures 65 supervision 66 senior management
B - User falls a)slide down b)topple over forwards c)fall sideways d)fall backwards e)other f)N/K	i)lost balance ii)over reach iii)other personal cause iv)footwear condition v)rung condition vi)other foot surface vii)hand-hold failed or inadequate viii)ladder flexing ix)external cause x)other xi)N/K	
C - Failure of support a)upper support point b)lower support point c)other d)N/K	i)unsuitable support ii)support not rigid iii)support moved away iv)ladder overload v)other vi)N/K	
D - Impact a)on ladder b)on user c)on support d)other e)N/K	i)vehicle ii)weather iii)other iv)N/K	
E - Ladder failure a)stile b)rung c)(step) -ladder connections	i)design/manufacture fault ii)incorrect selection iii)incorrect method of use iv)overload v)inadequate maintenance vi)incorrect maintenance vii)other viii)N/K	

N/K - Not Known

Table 3.5 - Breakdown of 'ladder slips' incidents

Accident cause		Cause of failure	Number	%
A Ladder slips	Sideways (a)	Inadequate securing (ii)	1	7.1%
		N/K (v)	1	7.1%
	Outwards (b)	Ladder not secured (i)	1	7.1%
		Inadequate securing (ii)	1	7.1%
		N/K (v)	1	7.1%
	N/K (f)	Ladder not secured (i)	3	21.4%
		Inadequate securing (ii)	1	7.1%
		Failure of securing (iii)	1	7.1%
		Other (iv)	2	14.3%
		N/K (v)	2	14.3%
TOTAL			**14**	

Note: Categories containing no incidents are not shown
N/K - Not Known

From Table 3.5 which shows "Ladder slips" incidents, it can be seen that more than half (64.2%) of the incidents which involve the ladder slipping fall into the accident cause subset 'not known', which means that from the descriptions it was not possible to tell how the ladder fell. The next largest group was that where the ladder slips outwards (21.5%). It is interesting to note that most of these incidents were caused by either the ladder not being secured (28.6% of 'ladder slips' incidents) or inadequate securing (28.6% of 'ladder slips' incidents).

From table 3.6 which shows "User falls" incidents, it can be seen that many (65.3%) of the incidents were not described in enough detail to allow the direction of the fall to be ascertained. The most common cause of the accident was 'other personal cause' (45.3% of the 'user falls' incidents), which was used to describe incidents where the IP slipped from the ladder and no reason is given.

Table 3.7, which shows "Impact" incidents indicates, that the existing 'secondary accident causes' categories do not really cover the type of incidents which are happening, as nine of the ten incidents have an 'other' cause.

There was only one incident which was described as a 'ladder failure', this was a loose rung which spun around (see Table 3.8).

Table 3.6 - Breakdown of 'user falls' incidents

Accident cause		Cause of failure	Number	%
B User falls	Slides down (a)	Other personal cause (iii)	9	9.5%
		Rung condition (v)	3	3.2%
		External cause (ix)	1	1.1%
		Other (x)	2	2.1%
		N/K (xi)	4	4.2%
	Topple forwards (b)	Other personal cause (iii)	2	2.1%
		Rung condition (v)	1	1.1%
	Sideways (c)	Other personal cause (iii)	1	1.1%
		Hand-hold failed/inadequate (vii)	2	2.1%
	Backwards (d)	Other personal cause (iii)	3	3.2%
		Hand-hold failed/inadequate (vii)	3	3.2%
		N/K (xi)	1	1.1%
	Other (e)	Other foot surface (vi)	1	1.1%
	N/K (f)	Lost balance (i)	3	3.2%
		Other personal cause (iii)	28	29.5%
		Rung condition (v)	1	1.1%
		Hand-hold failed/inadequate (vii)	4	4.2%
		External cause (ix)	4	4.2%
		Other (x)	4	4.2%
		N/K (xi)	18	18.9%
TOTAL			95	

Note: Categories containing no incidents are not shown
N/K - Not Known

Table 3.7 - Breakdown of 'impact' incidents

Accident cause		Cause of failure	Number	%
D Impact	On ladder (a)	Other (iii)	2	20%
	On user (b)	Weather (ii)	1	10%
		Other (iii)	7	70%
TOTAL			**10**	

Note: Categories containing no incidents are not shown
N/K - Not Known

Table 3.8 - Breakdown of 'ladder failure' incidents

Accident cause		Cause of failure	Number	%
E - Ladder failure	Rung (b)	N/K (viii)	1	100%
TOTAL			**1**	

Note: Categories containing no incidents are not shown
N/K - Not Known

Table 3.9 - Breakdown of 'other causal factors'

Other causal factors	**Frequency**
11 - Ladder suitability	1
12 - Ladder condition	1
13 - Ladder positioning	1
15 - Ladder 'footing'	1
16 - Ladder angle	1
22 - User training/competance	4
41 - Environment suitability	1
63 - Equipment selection	1

Note: Categories containing no incidents are not shown

3.4 Conclusions form ladder analysis

242 incidents for the period January 1991 to January 1998 supplied by OSD were considered. Of these 120 were found to be ladder incidents and were analysed.

Firstly the ladder type was analysed and the results are shown in Tables 3.1 and 3.2. It is interesting to note that almost 11% of the incidents were bunk bed ladder incidents.

Secondly the incidents were categorised using the FOD table shown in table 3.3 the results are given in tables 3.5 to 3.9.