THE OCCURRENCE AND DETERMINANTS OF ACCIDENTS: A CASE - CONTROL STUDY AMONG WORKERS IN THE ASSAB PORT.

BY

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I hereby, recommend that the thesis prepared under my supervision by Kitaw Demissie, M.D. entitled The Occurrence and Determinants of Accidents: A Case - Control study among workers in Assab Port be accepted in partial fulfilment of the requirements for the degree of MASTERS OF SCIENCE IN COMMUNITY MEDICINE - M.SC (Comm. Med.)

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To My Father

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TABLE OF CONTENTS

CHAPTER		PAGE
I.	INTRODUCTION	1
II.	LITERATURE REVIEW:	
	1. General	5
	2. Frequency rates:	
	a) General Accidents	6
	b) Port Accidents	15
	3. The Cost of Accidents	21
	4. Causation of Accidents	31
III.	METHODOLOGY:	
	1. Objective	49
	2. Design	50
	a) Preparatory phase	50
	b) Types of the study	50
	c) Population	51
	d) The research instrument	54
	e) Recruitment and training	55
	f) Pilot phase	56
	3. Definitions	56
	4. Collection of Data	56
	5. Handling of Data	57
	6. Analysis of Data	59

LIST OF FIGURES

FIGURES PAGE

TABLE OF CONTENTS (CONTD.)

CHAPTER		PAGE
IV.	RESULTS	62
V.	DISCUSSIONS	103
VI.	CONCLUSIONS AND RECOMMENDATIONS	116
VII.	ANNEX:	
	Annex A - Data Entry Format	124
	Annex B - ANSI Classification	131
VIII.	BIBLIOGRAPHY	143

LIST OF FIGURES (CONTD.)

FIGURES		PAGE
14.	Percentage distribution of accidents by place in Assab Port,1987	77
15.	Distribution of accident by day of the weeks,Assab Port,1987	79
16.	Accident rates by time of the day	81
17.	Time of accidents since the beginning of work,Assab Port,1987	83
18.	Distribution of accidents by their nature,Assab Port,1987	87
19.	Accidents by part of the body affected	88

LIST OF TABLES

TABLES		PAGES
Table 1.	All factories accident rates per 1,000 workers employed in India and U.K.	14
2.	Comparison of employment accidents in port operations and other activities	16
3.	Three years accident rates in Assab Port	21
4.	Financial statistics 1966,1967,1968	25
5.	Estimates for the national costs of occupational accidents: HMF± data	29
6.	Estimates for the national costs of occupational accidents: DHSS data	29
7.	Frequency of exposure among N case - control pairs	60
8.	Accident rates by departments involved, Assab Port 1987	62
9.	Rate of accidents by age involved,Assab Port,1987	62
10.	Rate of accidents by sex involved, Assab Port,1987	66
11.	Rate of accidents by ever attended educational status, Assab Port, 1987	68
12.	Rate of accidents by category of worker worker,Assab Port,1987	68
13.	Rate of accidents by payment method,Assab Port,1987	71
14.	Rate of accidents by the worker's job title, Assab Port,1987	74

LIST OF TABLES (CONTD.)

TABLES		PAGE
15.	% of accidents by their place of occurrence, Assab Port,1987	76
16.	Accidents by the day of the week,Assab Port, 1987	78
17.	Rates of accidents by shift of the day,Assab Port,1987	80
18.	% of accident time since beginning or work, Assab Port,1987	82
19.	Percentage distribution of accidents by their nature	84
20.	Accidents by part of body affected	85
21.	Percentage distribution of accidents by their source	89
22.	Accidents by their type	90
23.	Accidents by Major causes	91
24.	Distribution of hazardous conditions	92
25.	Distribution of unsafe acts	93
26.	Break-up of expenditure involved in port accidents (55 days)	95
27.	Relation of safety training to accidents	96
28.	Relation of sex to accidents	96
29.	Relation of the last one year sickness episodes to accidents	97
30.	Relation of previous sick days lost to accidents, dose-response	97

LIST OF TABLES (CONTD.)

TABLES		PAGE
31.	Relation of literacy status to accidents	98
32.	Relation of educational status to accidents, dose-response	99
33.	Relation of age to accident	99
34.	Relation of age to accident,dose-response	100
35.	Relatio of total work experience in the port to accidents	100
36.	Relation of work experience in the port to accidents,dose-response	101
37.	Relation of work experience within the same work category in the port to accidents	101
38.	Relation of work experience within the same work category in the port to accident, dose-response	102

LIST OF ABBREVIATIONS:

1. ANSI = American National Standard Method of Recording Basic Facts Relating to the Nature and Occurrence of Work Injuries.
2. IDRC = International Development and Research Center
3. NEC = Not Elsewhere Classified.

S U M M A R Y.

The high incidence of accidents related to the port in the awraja of Assab, during 1986-87 led to a more detailed observation and analysis of accidents in the port of Assab in 1987.

Some 6,500 workers are employed in the port of Assab, but of these 570 (8.8.%) are listed as " non- industrial", or are employed on work that is unlikely to bring them into contact with industrial hazards. The remainder 5,930 (91.2%), were on the list of the four departments principally concerned with industrial work. This number was made up of 5725 (96.5%) males , and 205 (3.5%) females.

To describe the occurrence and determinants of accidents among workers in the port of Assab, a one control per case (241 pairs) study, matched on the basis of their similarity with respect to the selected variables was designed. The study was conducted over a 55 days period, from October 16, 1987 to December 9, 1987.

The total number of accidents that occurred among workers exposed to the risk of accidents in the port of Assab were 241 (4.1%) , giving a rate of 8.2 accidents per 100,000 worked man-hours, 40.6 accidents per 1,000 exposed workers or 2.03 accidents per 100 employee - months.

The real highest department rate of accidents was produced by the departmet of Haleb boatyard construction project with an accident rate of 15.5 per 100,000 man-hours, 77.8 per 1,000 exposed workers or 3.9 per 100 employee - months.

No significant difference was noted in the rate of accidents among the worker's categories labeled as skilled, unskilled and apprentice.

The accident frequency was highest on Mondays and fell to its lowest level at mid-week, with an increase once more on Saturdays. The frequency rate of accidents was observed to be highest in the period of the second shift (8 p.m to 4 p.m) with an accident rate of 10.6 per 100,000 worked man-hours, 50.4 per 1,000 workers at risk, or 2.52 per 100 employee-months. This is probably due to the peak environmental temperature occurring in the second shift.

Analysis of man-days lost showed,1,571 total man days to be lost due to the 241 accidents over a period of 55 days. The average man-days lost per accident works out to 6.5, the range being from 0 to 91 days. The rate of seriousness in Assab port study was 0.5, and the index of seriousness was found to be 0.3.

Analysis of the cost of accidents showed 31,606 birr, the average being 131.2 birr per accident to be spent over the 55 days . This cost is only for the medical and man-days lost expenses and does not include the insurance payments and other indirect costs.

Analysis of accidents by category of causation showed both the environmental and human factors to be involved in 57% of the accidents. In 25.7% it was the environmental factor alone, and in 16.6% the human factor alone.

Among the causes by environmental factors, the most frequent causes were : defects in agencies (35.2%) hazardous methods or procedures (22.5%), and placement hazards (22.4%).

Among the causes by the human factors, the most frequent were = inattention to footing or surroundings (18.4%), improper use of hands or body parts (18%), and failure to wear safe personal attire (12.3%) . The main determinants identified for the human factors from this study are; age of the worker, educational status of the worker, job title of the worker, experience of the worker in the port of Assab, and work shift of the worker. Thus the risk groups identified for the epidemiology of accidents in the port of Assab include : port workers between the ages of 18-24 years, port workers with no formal education , Port workers classified as " electricians, welders, plumbers, and carpenters"., and port workers who are employed to work in the second shift.

From the findings of this study, the recommendations given are:-

1. *A firm and well defined policy.*
2. *Employment of a fulltime Safety Officer in the port.*
3. *Formation and Organization of a safety committee in the port.*
4. *Introduction of an effective investigation and recording system of accidents in the Assab port.*
5. *To adopt a systematic inspection and follow-up system by various level of personnel, till all the environmental factors identified as a cause of accidents in the Assab port are rectified, and*

6. *Strong efforts in the areas of safety training and education, safety supervision and safety communication to the risk groups identified are necessary to effectively reduce the accidents resulting from the human factors.*

CHAPTER I. INTRODUCTION

Work related to the port represents a special industrial hazard. The port is the link between the sea and other routes or means of transport and it involves hazardous conditions dictated by the lay-out of the places where work is to be performed: operations take place in close proximity to the water, either on the dock side and in the neighbouring warehouses and sheds or on boardships and floating objects.

In economic terms, the port is a meeting place for various economic sectors and it differs from the classic form of business enterprise in that it has none of its unity of management or interests. Work done there does not reflect the operations of a single economic agent, but rather the combined effort of users or their representatives (transit agents), the various suppliers of services (carriers, handlers) and the port authority managing the harbour as well as the government, which has administrative, policing and supervisory functions(18).

These various enterprises, which employ different personnel who often do not know one another or even speak the same language, have to work together and perform their operations in such circumstances that is often no easy task to safeguard the safety of the workers.

The difficulty is further increased by the fact that the work is intermittent, and gangs made up in different ways are formed to perform a collective job limited to the time needed to handle the cargo in question.

In the North-Eastern part of Ethiopia, there is established one port which can accommodate seven ocean going ships at a time. Some 6500 persons are employed in the Assab port, but of these 570 (8.8%) are listed as "non-industrial", or are employed on work that is unlikely to bring them into contact with industrial hazards. The remainder 5930 (91.23%) were on the books of the four departments principally concerned with industrial work. This number is made up of 5725 males and 205 females, making 96.5 and 3.5 percent respectively.

The safety problems arising in connection with the work in the port are:

For work on boardship or floating objects: the transport of persons between the shore and the floating object, access to the ship, the movement and presence of persons on board, transport of goods on boardship, and the mooring and unmooring of vessels.

For work on dry land: the movement and presence of persons on the dockside, transport and storage of goods on open ground or in sheds and warehouses, and trans-shipment by means of equipment on boardship or on land(18).

Three years ago, the Assab port authority established a safety section to coordinate the safety and health in the port. This section is served only by one BA graduate in social science. He was hired for another purpose and is a part time worker for the safety and health section.

His job description with regard to safety and health is to record the accident which occur in the port and to facilitate insurance and compensation payments to the workers. Accidents were being recorded since the establishment of the safety and health section, but it had never been analyzed. The recording of accidents was also inaccurate and the degree of severity was not noted.

In 1986 - 87 the accident rate in the Assab port was 14.5 per 100,000 worked hours and close to a million birr (913,412.20) was spent for medical and insurance payments. This figure does not include indirect (hidden) accident costs such as cost of lost time of injured person, cost of time lost by foremen supervisions assisting injured employee, cost of time spent on the case by first-aid attendant and hospital department staff etc....

Within the same year one worker died as a result of an accident, and in 1985 - 86 there were six deaths in the Assab port.

The cost of the accidents together with the mortality and morbidy is a big drain on an already precarious economy and is a major and potentially modifiable health problem in the Awraja.

The above findings forced us to undertake accident investigations in the Assab port.

As there is no reported Ethiopian data on the occurrence, determinants and causation of accedents in the port, the present study provides information on the major causes of accidents, the relative frequencies of all causes, consequences and cost of treatment and cost of accidents in general. It also develops a method useful for the planning of preventive strategies and their implementation in the future.

The specific objectives are:-

(a) To determine the incidence density of all causes of accidents in Assab Port.

(b) To describe the rate of accidents by age, sex, educational status, loacation of accident, day of the week, time of theday, healthyy facility attended, experience of work, work category, department, work site, title of worker and number of illness episodes

(e) To describe the percentage distribution of accidents by the nature of injury, part of body affected, source of injury, Accident type, major causes and severity.

(d) To describe the environmental health and safety methods existing in the port.

(e) To describe cost of accidents in general, and

(f) To plan preventive strategies for accident in the port.

In addition, several hypothesis of association with the occurrence of accidents are to be tested.

H1. That the rate of occurrence of accidents is inversely related to the educational status of the worker.

H2. That accidents occur more frequently in the night shift than the day shift.

H3. That the rate of occurrence of accidents is directly related to the number of sickness episodes in the patient within the last one year.

H4. That accidents occur more frequently in those who does not have safety training that with safety training.

CHAPTER 2. *LITERATURE REVIEW*

Every year, throughout the world, millions of industrial accidents occur. Some of them are fatal and some result in death. The great majority cause only temporary disablement, which, however, may last for several months. Every accident causes suffering to the victim, a considerable proportion must cause much anguish to his or her family, and many-especially those resulting in death or permanent disablement may have a catastrophic effect on family life. Moreover, all accidents waste time and money.

The world is still paying heavily for accidents in terms of both human suffering and economic waste. Despite some progress, the question of safety at work is still a serious problem.

Some idea of the size of the problem can be given by recalling that, during the six year period of the Second World War, far more people were injured in accidents at work all over the world than were wounded as the result of hostile action (1)

The figures given for the United Kingdom and the United States of America amply illustrate the point . Over the duration of the war, monthly casulties in the armed forces of the United Kingdom (excluding merchant seamen) averaged 3462 killed, 752 missing and 3912 wounded - a total of 8126. During the six years from 1939 to 1944, in manufacturing industry alone including docks and shipyards , the monthly average was 107 deaths and 22,002 injuries. In the United States armed forces during the

.../

second world war, the average monthly losses were 6084 killed, 763 missing and 15,161 injured, a total of 22,008 while the monthly average of industrial casualties during the years 1942 -44 was 1219 persons killed, 121 permanently and totally disabled, 7,051 permanently and paitally disabled and 152,356 temporarily disabled - a total of 160,747.

It can thus be seen that in these two countries industrial injuries caused more casulties (leaving aside for the moment all questions of relative severity) than the operation of a major war.

1. FREQUENCY RATES

GENERAL ACCIDENTS

Every year in the United Kingdom about 1,000 people are killed at their work. Half a million workers suffer various injuries (2).

Today some countries (Japan, United States) regularly report over 2 million occupational accidents a year, and others (France, Federal Republic of Germany, Italy) over a million. Many countries, including some of the largest or most highly industrialized, still do not publish any figures, but it is fairly safe to assume that over 15 million occupational accidents occur throughout the world every year - a staggering number when considered in terms of the suffering, sorrow and waste they cause (3).

.../

The International Labour office publishes comprehensive tables by individual member states of the annual indidence or frequency rates of fatal accidents for four industrial groups; manufacturing, construction, railways, and mining and quarrying . Published rates for some European community countries and certain other major industrial countries are presented in the figures below. Differences in definitions of other accidents are thought to be so wide as to invalidate any significant international comparison, but the trends are evident. Also, the fatal accident rates quoted for the different countries vary in definition and in the nature of the information used to calculate them. The main distinction is between incidence rates, which relate deaths to number of wage earners or employees (or work-years) and frequency rates which relate deaths to work hours.

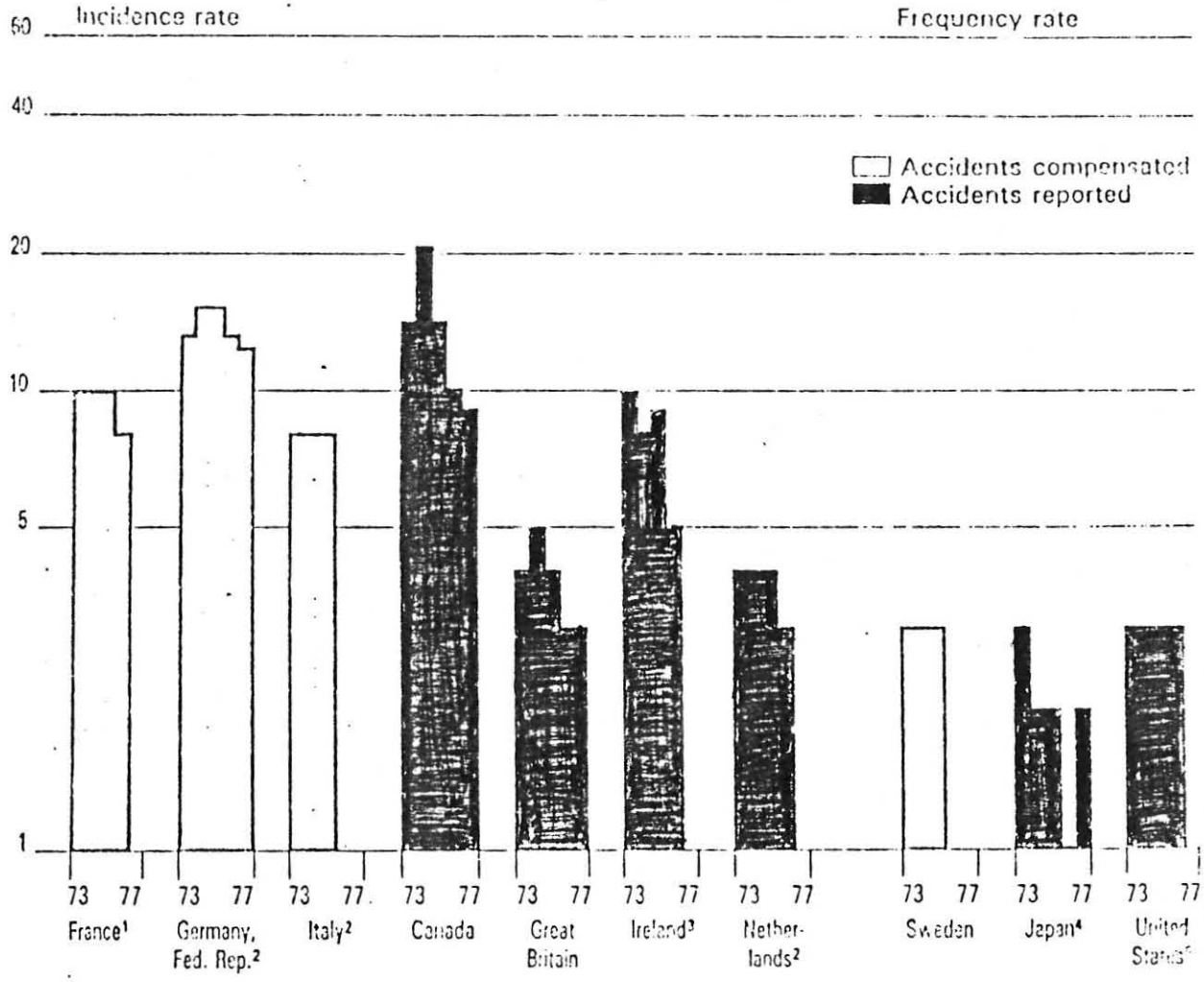
In a report on working conditions and environment submitted to the International labour conference in 1975, the Director - General of the International Labour Office gave an account of the situation with regard to occupational injuries in which it was stressed, in particular, that the accident frequency rates had stagnated in most of the industrialised countries and had risen in the developing countries (3).

The situation has not changed substantially since that time, as many be seen from the frequency rates of total occupational accidents in those countries for which comparable

..../

data covering several years are available. While some industrialised countries have succeeded in breaking through the levels of those frequency rates and in setting them on a slightly downward course, other industrialised countries have not yet been able to do so. The figures below illustrate the point.

Figure 1. Fatal accident rates in manufacturing industry for selected countries, 1973-77

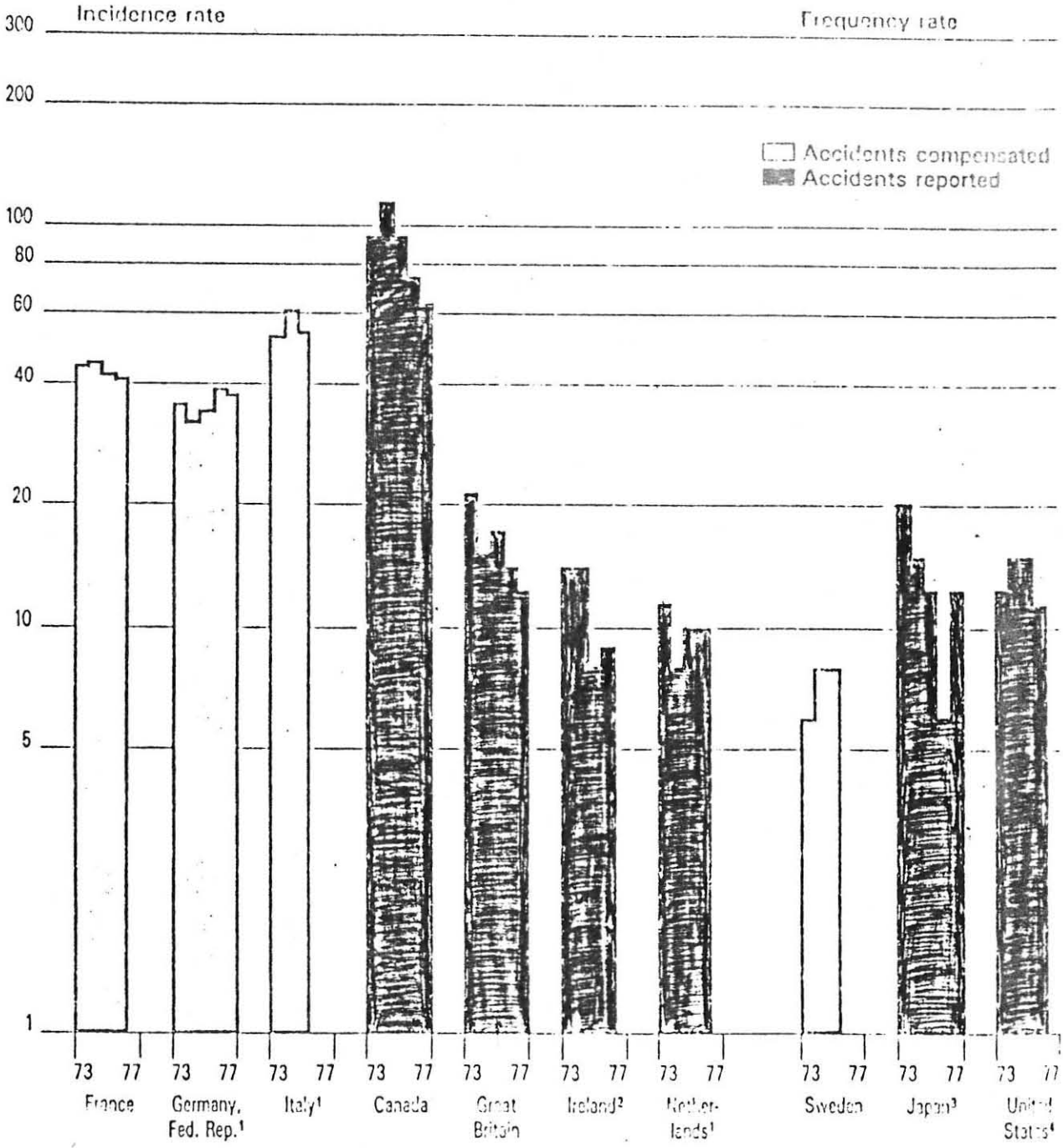


Incidence rate: deaths per 100,000 employees
Frequency rate: deaths per 100 million work-hours

[1] Including mining and quarrying. [2] Based on standard work-years of 200 working days. With a five day week, accidents per actual work-year are likely to be some 20 per cent fewer. [3] Rate per 100,000 wage earners. [4] Establishments employing 100 or more workers. [5] Based on sample surveys.

Sources: London, Health and Safety Executive, Geneva, International Labour Office.

Figure 2. Fatal accident rates in the construction industry for selected countries, 1973-77

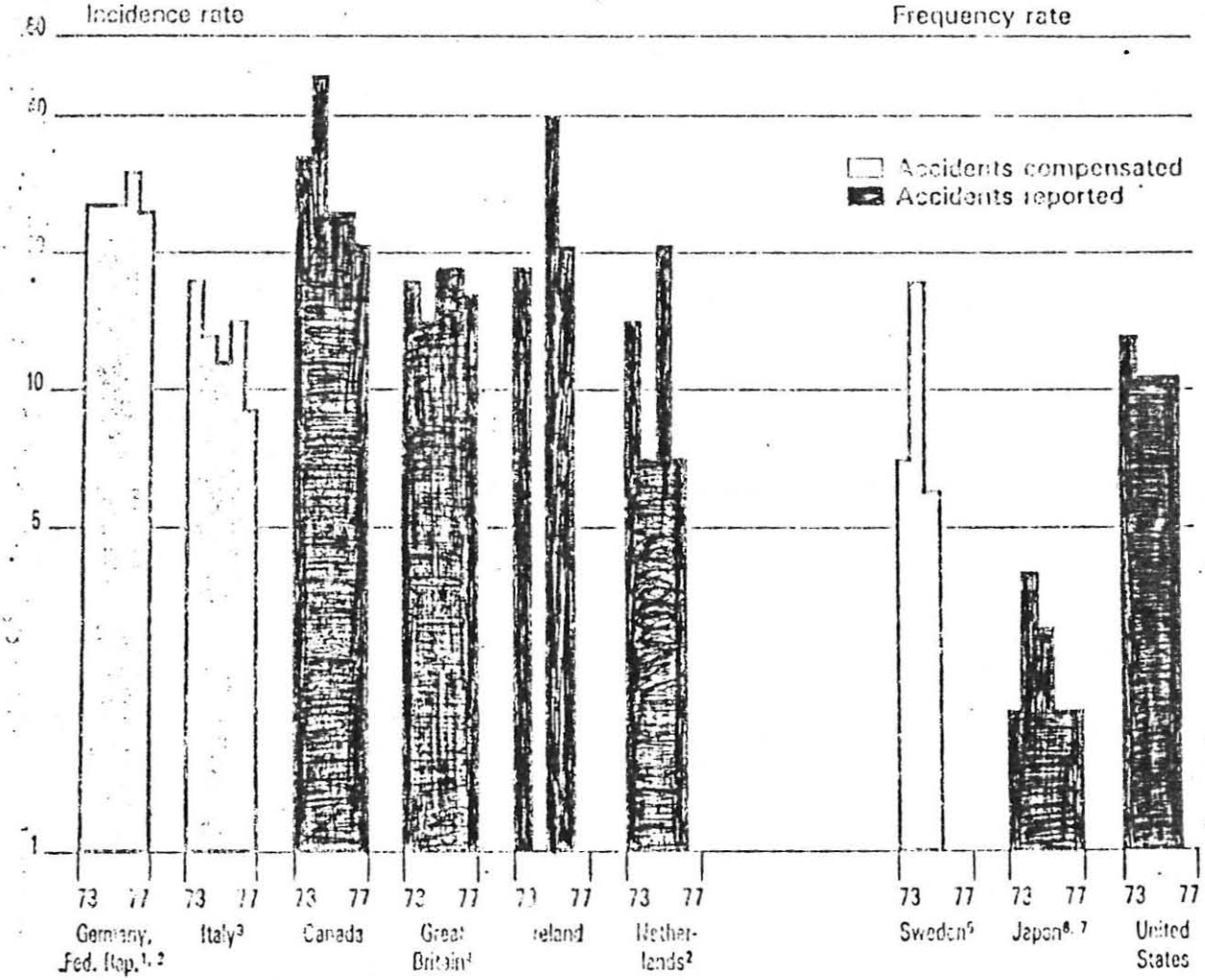


Incidence rate: deaths per 100,000 employees
Frequency rate: deaths per 100 million work-hours

[1] Based on standard work-years of 300 working days. With a five-day week, accidents per actual work-year are likely to be some 20 per cent fewer. [2] Rate per 100,000 wage earners. [3] Establishments employing 100 or more workers. [4] Based on sample surveys.

Sources: London, Health and Safety Executive; Geneva, International Labour Office.

Figure 3. Fatal accident rates on the railways for selected countries, 1973-77

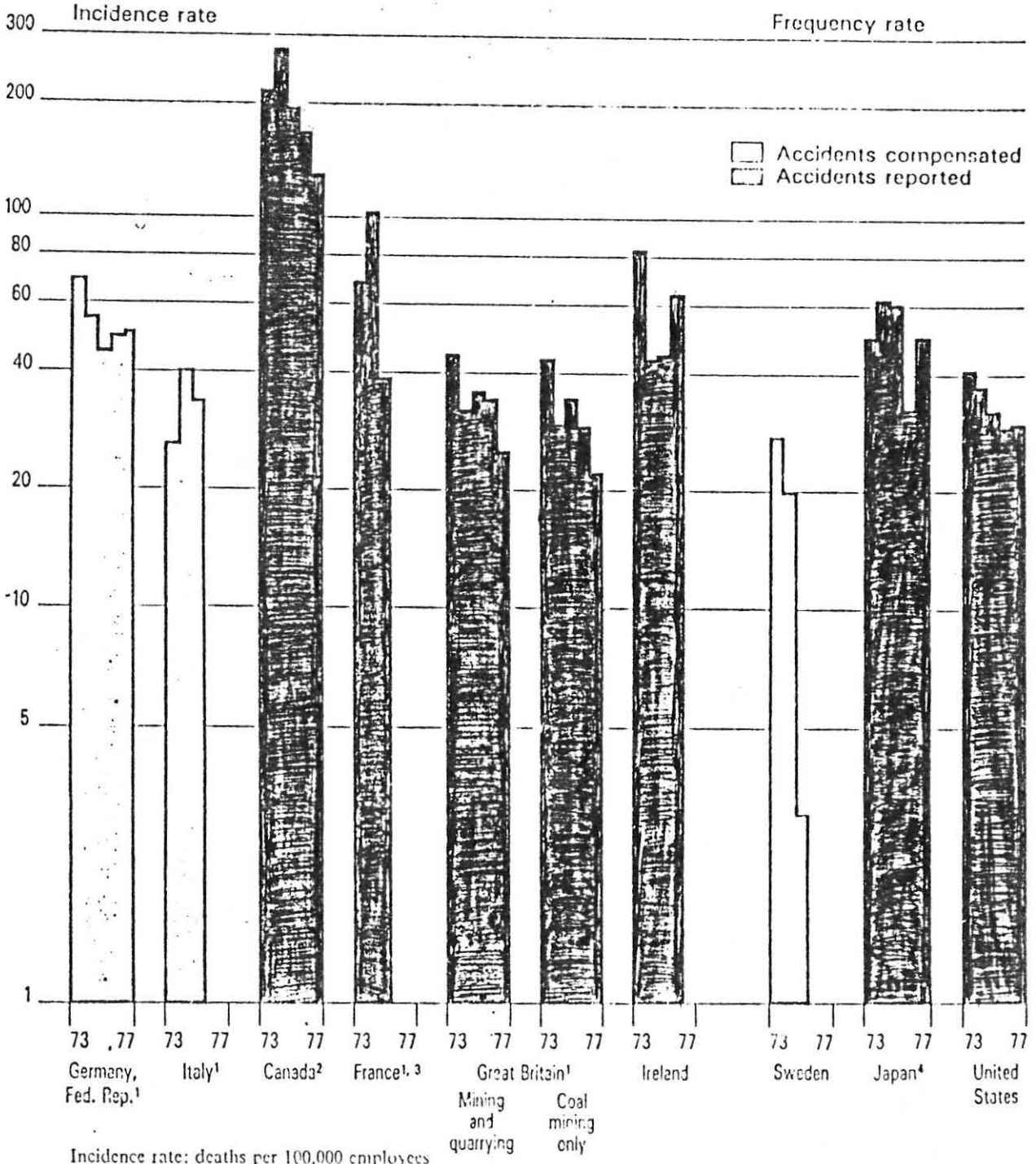


Incidence rate: deaths per 100,000 employees
Frequency rate: deaths per 100 million work-hours

[1] Including railway workshops and accidents involving road vehicles operated by federal railways. [2] Based on standard work-years of 300 working days. With a five-day week, accidents per actual work-year are likely to be some 20 per cent fewer. [3] Regular staff only; including railway workshops. [4] Rate per 100,000 wage earners. [5] Including railway workshops and construction of railway lines. [6] Including railway workshops. [7] Establishments employing 100 or more workers.

Sources: London, Health and Safety Executive; Geneva, International Labour Office.

Figure 4. Fatal accident rates in the mining and quarrying industries for selected countries, 1973-77



Incidence rate: deaths per 100,000 employees
Frequency rate: deaths per 100 million work-hours

[1] Based on standard work-years of 300 working days. With a five-day week, accidents per actual man-year are likely to be some 20 per cent fewer. [2] Rate per 100,000 wage earners. [3] Excluding quarrying. [4] Establishments employing 100 or more workers.

Sources: London, Health and Safety Executive; Geneva, International Labour Office.

So far, we have been considering mainly the industrialised countries, but nowhere is the problem of accidents more acute than in the developing countries. In the majority of these, the frequency rates of fatal occupational accidents, which are the only ones for which reliable data are available, show a marked upward trend; it is not unusual to find that the rates have doubled or tripled over the past ten or 15 years, or risen even more in those sectors of economic activity which have undergone a particularly rapid growth in the country concerned. The positive result that have been obtained in a very samll number of developing countries emphasise all the more, by contrast, the failure of the others to reduce their accident rates.

The situation is made far worse in the developing countries because protective laws may not exist; or if they do, they are rarely enforced. Also where unemployment is endemic, the availability of large labour force reserves does not always result in improvements in safety. Poverty and ignorance also add to the problem. Figures which compare accident rates between India and United Kingdom are presented.

TABLE 1. *ALL FACTORIES ACCIDENT RATES FOR 1,000 WORKERS EMPLOYED IN INDIA AND UNITED KINGDOM*

YEAR	INDIA	UNITED KINGDOM
1968	55.93	33.80
1969	63.48	35.30
1970	67.56	36.30
1971	75.85	33.40

It can be seen that the rates of accidents in the Indian factories are considerably higher than those in the United Kingdom (4).

A representative sample descriptive study of accidents in an Indian cotton textile factories - spinning processes showed an accident rates of 141, 27.6, 15, 61 and 296.9 per 1,000 workers in the five mills of the spinning process (5)

An Indian representative sample accident study in the Textile factories weaving preparatory and weaving processes mills showed an accident rate of 94, 97.5, 87, 78 and 130 per 1,000 workers in the five different mills (6).

A representative sample of accidents in cotton textile factories of India in the 5 mills of the finishing processes also revealed an accident rate of 302.9, 197.5, 178.9, 177.8 and 198.6 per 1,000 workers in the five mills (7).

..../

Investigation of accidents among 4,660 technical personnel in railways at Allahabad, India showed an accident rate of 49.35 per 1,000 workers (8) which follows those in mine workers in India i.e. 49.39/1,000 workers (9) .

So far, we have been considering general accidents, now we will consider accidents related to the port.

PORT ACCIDENTS

Among the many occupational accidents that occur in the World, port accident comprise a significant percentage. In spite of increasing mechanization, the biomechanical demands of port workers are still heavy and the insults resulting from load handling and other activities in the port are reflected in the high morbidity statistics of "wear and tear" conditions.

The information obtained concerning employment accidents in foreign ports is of great intrinsic interest.

Three returns prepared by the National Wage Earners Sickness Insurance Fund showed that for all the French ports, the frequency rates are 29.4 in 1968 and 31.9 in 1969 per 100,000 man-hours worked (10). The same study compares employment accidents in port operations and other activities as shown in the table below:

.../

TABLE 2. Comparison of employment accidents in port operations and other activities.

Statistical elements	Maritime Dock workers	Transport and goods handling	All Industry
Frequency rate[4]	29.4	54[2]	43[2]
Degree of seriousness of permanent incapacity	12	1.65[2]	1.05[2]
Index 8 seriousness of permanent incapacity[4]	424	91.1[2]	53.4
Over-all rate of risk[4]	37.5	3.64[2]	2.21[2]
Average cost of ordinary accident	1999F	1093F[3]	879F[2]
Average cost of serious accident	11240 F	13015 F[3]	11494 F[3]

1. STATISTICS FOR 1968
2. STATISTICS FOR 1967
3. AVERAGE STATISTICS 1966 - 1968
4. THE CORRESPONDING DEFINITIONS AS

$$\text{Frequency Rate} = \frac{\text{No. of accidents} \times 100{,}000}{\text{No. of hours of work}}$$

$$\text{Rate of seriousness} = \frac{\text{No. of days lost} \times 1000}{\text{No. of hours of work}}$$

$$\text{Index of seriousness} = \frac{\text{Total of permanent incapacity rates} \times 1{,}000{,}00}{\text{No. of hours of work}}$$

$$\text{Total rate of risk} = \frac{\text{Temporary incapacity benefits plus lump-sum benefits in respect of serious accidents} \times 100}{\text{wages subject to social security contribution.}}$$

From this it is seen quite clearly that the dock-worker risk is not only much higher than the risk for all industry but also considerably above the rate for transport and goods handling, which is one of the branches with the highest accident rates.

What is even more noteworthy is the fact that employment accidents among dock-workers are more serious than elsewhere. The degree of seriousness of temporary incapacity, which is seven times higher than for transport and goods handling while the index of seriousness for permanent incapacity is four times higher. The exceptional character of the seriousness of accidents among dockworkers is reflected in the financial consequences, because the global rate for the dockworker risk is ten times greater than the rate for transport and goods handling. It is difficult to make any valid comparison between these two rates, however, because the wage subject to social security contributions, on which calculation of the relevant rate is based, represents only about a half of the real wage of dockworkers, whereas in other occupations, for production workers at least, the two rates are pretty well the same.

Information on the incidence of reportable "three day" industrial injury in London, United Kingdom, has been abstracted from the 1966 annual Report of Her Majesty Chief Inspector of

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Factories (Factory Inspectorate, 1966) and from the half-yearly returns of the National Association of Port Employers (1966) for the same period; appears 132 injuries per 1,000 dockers at risk, 66 per 1,000 at risk in shipbuilding and repairing (11).

A nine - year record of injury frequency rate for long-shoring in the U.S.A. is presnted in figure 5 below (12). It shows a drop in the injury frequency rates over the years and is due to strict safety rules, training and supervision.

C.P. Collins from the Royal Naval Hospital analyzing accidents in a naval dockyard found an accident rate of 2.38 per 100 employee - months which is much below from rates published for industrial workers in Britain (13).

Even though there is no reported Ethiopian data on port accidents, analysis of the accident records of the past three years in the Assab port shows accident rates as follows (Table 3):

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FIGURE 5. INJURY FREQUENCY RATE - NINE YEAR RECORD

LONGSHORING:

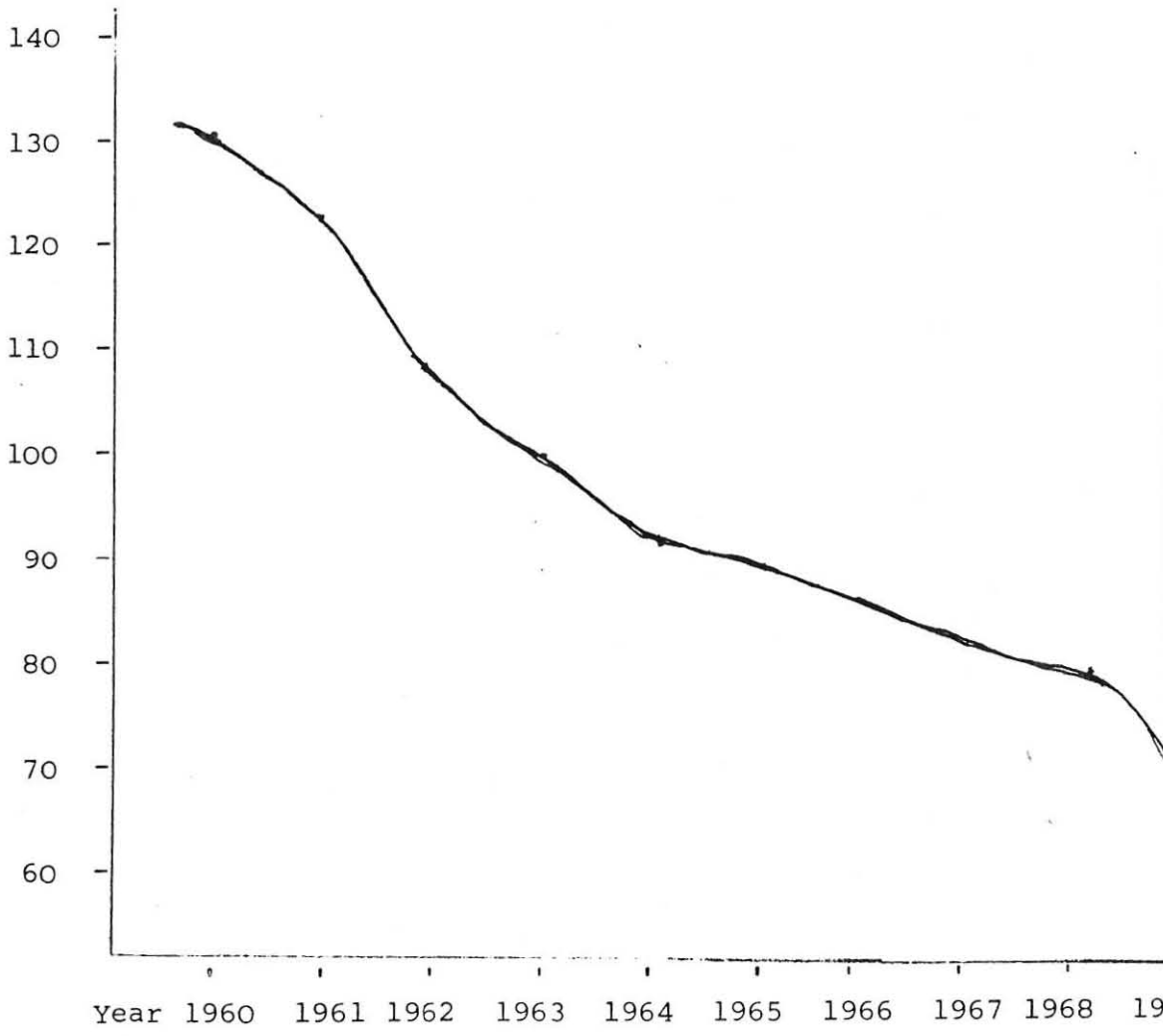

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Table 3: Three years Accident rates in Assab Port.

1984 - 1987.

Year	No. of accidents	Frequency rate per million worked hours	Frequency rate per 1000 workers at risk
1984 - 85	448	95.12	378.1
1985 - 86	857	105.31	348.8
1986 - 87	2022	145.73	446.2

One cannot compare accident rates of 1984-85, 1985 - 86 to that of 1986-87, since there is a problem of reporting i.e. civil engineering workers and worked hours for the 1984-85 and 1985-86 were not included.

There were 7 deaths that occured in the Assab Port due to accidents in 1985/86 and 1986/87.

In the near future, as Ethiopia is getting industrialised, the accident rate is expected to rise.

2. THE COST OF ACCIDENTS

Much has been written about the economic cost of industrial

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accidents but few attempts have been made to asses it accurately. It is important to question whether meaningful costs can actually be given to accidents,and, if so, what use can be made of them in terms of accident prevention. After all, what price can be put on a person's life?

The economics of accidents is inevitably linked to the economics of accident prevention. It is well known that damage and injury entail costs as does accident prevention. If the cost of accidents actually appears on a balance sheet, the employer, who is ultimately responsible, can integrate measures for accident prevention into the overall plans for the firm.

GENERAL ACCIDENTS

Various estimates have been made for the annual cost of industrial accidents in strictly monetary terms. In Great Britain, for example, Beckingsale in 1963 estimated the cost of industrial accidents to the nation at £ 264 million. In 1970, Hanna put the cost at £ 220 million. In safety and health at work, the Report of the Committee under the Chairmanship of Lord Robens (1970 - 72) estimates ranging from £ 200 million to £ 900 million were put forward as the total cost of accidents and industrial diseases in 1969 represented 0.87 percent of the gross national product (14).

Figures exist for other countries and have been published in various texts over the past few years. For example, an American author estimated that in 1953 each lost-time injury (i.e. an injury involving absence from work for a certain time)

.../

in industrial employment in the United States cost the employer approximately US$1,800 (15). According to the same author the American Social Security Administration estimated that in a typical year it paid out compensation amounting to approximately US$535 million while the national Safety Council estimated its medical expenses at US$130 million, making a total direct expenditure of US$665 million. The number of lost-time injuries which gave rise to this expenditure was 1.95 million; thus the average cost of each was US$340.

Other readily available statistics for the United States put the cost of accident injuries in 1965 at US$11,000 million, and that figure excludes material damage. As stated earlier, the National Safety Council estimated the cost of accidents at US$51,100 million in 1976.

In an Indian representative sample of accidents in cotton textile factories spinning processes and preparatory from 1970 to 1974 by inspecting the site of accidents and interviewing the injured persons, co-workers, supervisors and other concerned officials including the Mill managers shows a total of man days lost to be 10,381 as a result of 838 accidents. The average man-days lost per accident works out to 12.4, the range being 6.0 to 79.5 (16).

.../

In an Indian representative sample of accidents in cotton textile factories weaving preparatory and processes from 1970 to 1974 for 1,019 accidents making the sample of the study. A total of 10,609 man-days were lost due to these accidents representing an average of slightly more than 10 man-days per accident (17).

In the above 2 Indian studies only the lost man-days were reported which comprises a very samll percentage of the overall accident costs. It is very difficult to compare those figures to accident costs reported in other countries.

The study conducted on 4,660 technical personnel in Allahabad Railway zone, Indai, from October 1976 to September 1977 showed expenditure incurred to the railways due to accidents, due to loss of man-days interms of their salaries, compensation and medical care to be Rs.371,452.00 in 230 injuries. On an average, there was an unproductive investment of Rs. 1516.00 on each injury sustained during one year (18).

This study included all cases of accidents occurring at place of work, in home or on road and injuries that had caused at least 24 hours restriction of work to the individual. Inclusion of non-occupational accidents and the definition used for cases invalidate any International comparisions.

.../

PORT ACCIDENTS:

For all of the French ports financial statistics prepared by the National Union of Goods-Handling Industries on the basis of statistical information presented by the National Sickness Insurance Fund is presented in the table below (18).

Table 4. FINANCIAL STATISTICS 1966 - 1967 - 1968

	1966	1967	1968	1966 1967 1968
Temporary incapacity benefits	13,967,520	14,699,260	12,855,160	41,521,940
Lump-sum benefits paid in respect of serious accidents (claims against third parties deducted)	10,850,100	10,990,960	12,201,310	34,042,370
Wages	68,527,640	63,075,450	66,812,040	198,415,130
Total rate of risk	36.3	40.7	37.5	38.0
Average cost of an ordinary accident	1,720	1,980	1,999	1,880
Average cost of a serious accident	9,100	10,290	11,240	10,160

.../

(Table continued)

$$\text{Total rate of risk} = \frac{\text{Temporary incapacity benefits plus lump-sum benefits in respect of serious accidents} \times 100}{\text{wages subject to social security contributions.}}$$

But what of the 1980s? According to estimates recently made in some of the industrialized countries, the average overall costs of occupational accidents and diseases is equivalent to about 4 percent of the gross national product of those countries. That represents a large increase over any previous estimates (19).

It is important to explain what precisely is meant by the total or overall cost of accidents because, whereas many of the costs of accidents can readily be expressed in monetary terms, others are less tangible. According to some authors, accident costs are made up of direct or subjective expenses comprising, for example, personal suffering and bereavement of the victim's family, and indirect, hidden or resource expenses which include material damage, loss of equipment, expenses resulting from loss of productions and so on (19). There appears to be little agreement on what precisely constitutes an indirect cost, largely because so many variables are involved. As long ago as 1959, Heinrich listed the following hidden accident costs:

.../

1. *Cost of lost time of injured employee*

2. *Cost of time lost by other employees who stop work*

   - *Out of curiosity;*
   - *Out of sympathy;*
   - *To assist injured employee:*
   - *For other reasons*

3. *Cost of time lost by foremen, supervisors, or other executives as follows:*

   - *Assisting injured employee;*
   - *Investigating the cause of the accident;*
   - *Arranging for the injured employee's production to be continued by some other employee,*
   - *Selecting, training, or breaking in a new employee to replace the injured employee;*
   - *Preparing state accidents reports, or attending hearings before state officials.*

4. *Cost of time spent on the case by first-aid attendant and hospital department staff, when not paid for by the insurance carrier.*

5. *Cost due to damage to the machine, tools, or other property or due to the spoilage of material.*

6. *Incidental cost due to interference with production, failure to fulfill orders on time, loss of bonuses, payment of forfeits, and other similar causes.*

.../

7. *Cost to employer under employee welfare and benefit systems, and so on.*

More recently, other authors have suggested that there may be as many as 26 factors involved in indirect costs (19).

Let us look at some estimates of the cost of industrial accidents in Great Britain based on two sets of figures which illustrate some of the differences between direct and indirect costs in strictly monetary terms. The figures in table 5 are based on information provided by Her Majesty's Factory Inspectorate (HMFI) and relate to employed persons killed or injured in accidents at premises covered only by the Factories Act. Those in table 6 are based on statistics from the Department of Health and Social Security (DHSS) and relate to accidents arising out of , and occurring in the course of, employment covered under the national Insurance (Industrial Injuries) Act.

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Tabe 5. Estimates for the national costs of occupational accidents : HMFI data

Costs	Amounts (£)
Direct Costs	36626000
Indirect costs	97291226
Fatalities	8277043
Industrial accidents	54731681
Under - reporting	19774952
Non-reportable accidents	14507550
T O T A L	133917226

Assuming damage and administration costs of £ 50 per accident.

Table 6. Estimates for the national costs of occupational accidents: DHSS data.

COSTS	Amount (£ Million)	
	Conservative estimate	Best estimate
Direct Costs	110.59	127.42
Fatalities	9.59	9.59
Serious injury	21.04	42.8
Slight injury	79.96	75.75
Indirect costs	184.00	205.2
Fatalities	20.2	20.2
Industrial accidents loss of out medical & hospital costs Damage and administration costs Long-term incapacity Non-reportable accidents	84.5 8.1 25.2 8.1 37.9	84.5 12.4 42.1 8.1 37.9
T O T A L	294.59	332.62

.../26

Although these figures may not apply directly to other countries, they do indicate the way in which the component cost of accidents can be measured. They also allows a comparison or ratio to be drawn from the direct and indirect costs. In the HMFI data, this indirect/direct cost ratio is roughly 3 to 1. The ratio in the DHSS data is roughtly 2 to 1. One of the first proponents of the use of this ratio, Heinrich, in 1959, cities ratios varying from 2.3 : to 101:1 (19)

Although it is now generally agreed that the indirect cost amounts between two and five times the direct cost, depending on the circumstances, many authors have, nevertheless, questioned whether it is meaningful to compare such figures, as the ratios vary considerably from industry to industry depending on the type of injury, the damage caused and many other variables . Certainly it is important to put costs to accident, but they must be real costs upon which positive action in terms of accident prevention can be based, rather than nebulous costs which often cloud the issue and are open to dispute from all sides of industry. A good example of real costs is the cost of workers' compensation. There can be no doubt that increases in workers' compensation over the past few years have been an important factor in bringing to the attention of all concerned the urgent need for improvements in accident prevention measures.

.../

For example, the total cost of workers' compensation paid by United States business firms rose ten-fold from just under US$ 732 million in 1948 to over US$7,000 million in 1976

As was stated earlier, the economics of accidents is closely associated with the economics of accident prevention. As more money is spent on accident prevention, so the cost of accidents is reduced. However there must come a point when, theoretically, more money could be spent on accident prevention than is saved in total accident costs. However, one is reminded of the question what monetary value can be placed on a person's life and limb?

3. CAUSATION OF ACCIDENTS AND VARIABLES ASSCIATED WITH ACCIDENTS.

In every sphere of human activity there is the possibility of an accident, and work is no exception. Industrial accidents are the end - products of unsafe acts and unsafe conditions of work. However , accidents are preventable - they do not just happen. They usually occur as a result of the combination of a number of factors of which the three main ones are technical equipment, the working environment, and the worker.

.../

Much thought has been given to the study of causes of accidents. Accident causation is a complex subject and various theories have been put forward to explain how accidents happen and how they can be avoided in the future (20)

The "PURE CHANCE " theory implies that accidents are "acts of God" that there is no discernble pattern in the chain of events leading up to the accident, and that, as the name of the theory suggests, they depend entirely on chance.

The "ACCIDENT PRONE THEORY" suggests that some workers are more likely than others to have an accident due to innate personal characteristics. In other words, these workers are always likely to have an accident and very little can be done to prevent it. To ascribe the causation of an accident merely to "carelessness" on the part of a worker does nothing to identify the real cause.

These and similar negative fatalistic theories have done little to advance the cause of accident prevention. They are easy excuses rather than root causes.

.../

One method employed to throw some light on the actual causes of industrial accidents is classification. There are many different methods of classifying accidents according to causes; some are known as simple classification systems and others as multiple classification systems. Nearly every country has a different method. Some classify accidents according to where the fault lies, others classify them according to the cause. In some cases this has been done on the basis of a resolution adopted by the First International Conference of Labour Statisticians, Organised by the ILO in 1923, which recommended a simple classification system of accidents by cause containing the following main headings: machinery, transport equipment, explosions and fire; poisonous, hot or corrosive substances, electricity ; falls of persons, stepping on or striking against objects, falling objects, handling without machinery; hand tools; and other causes.

This simple classification based on the cause of the accident proved unsatisfactory because of widespread interpretations of each cause, and because of the number of factors that, in combination, may result in an accident.

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Accordingly, to overcome the objections, a number of countries and agencies within those countries adopted a more comprehensive multiple classification system in an attempt to indentify under several possible heading the various factors involved in an accident.

One multiple classification system is that of the American National Standards Institute (21). Each essential factor of the accident falls into one of the following seven clas

(a) nature of

(b) part of bo ed

(c) source of injury

(d) accident type

(e) hazardous condition

(f) agency of accident

(g) unsafe act.

In October 1962, the Tenth International Conference of Labour Statisticians, convened by the ILO, adopted a standard multiple classification system to replace the 1923 cause classification (20). According to this system industrial accidents are to be classified under each of the following four headings: (a) the type of accident, (b) the agency; (c) the nature of the injury; and (d) the bodily location of the injury.

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Whatever form of classification is adopted, it appears that the most common causes of accidents are to be found, not in the most dangerous machines (such as circular saws, spindle-moulding machines and power presses) or the most dangerous substances (such as explosives and volatile flammable liquids) but in quite ordinary actions like stumbling, falling, the faulty handling and lifting of goods or use of hand tools, and being struck by falling objects (20).

GENERAL ACCIDENTS :

In Great Britain in 1977, an analysis of factory (process) accidents revealed that 30 percent of the total accidents occured in handling goods, 16 percent were falls and 14 percent machinery accidents. Similarly an analysis of construction (process) accidents for the same period indicated that nearly one-third of all accidents in building operations were caused by falls, while over one-quarter occur in handling goods. At engineering construction works, the most common type of accident was in handling goods (nearly 20 percent) (22).

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In a 230 accident study among 4660 technical personnel in railways at Allahabad, India during one year hit by or against an object was the commonest " agent factor", "falls" being next, these agent factors together causing more than 88 percent of accidents. The commenest resultant injury was laceration in 121 cases, while considerably large number of cases (42) resulted in fractures. In attentiveness, lack of concentration and of supervision were important contributary factors (23).

An Indian study, Accidents in Cotton Textile Factories - spinning Preparatory and spinning process, unsafe physical or mechanical conditions were the major cause in 60.5 % of the accidents. Unsafe actions being the major cause in the remaining cases. Nearly 85% of the accidents in which unsafe conditions were the major cause were caused by the following 2 types of unsafe conditions - defective condition in agency and hazardous arrangement procedure , method inhereat hazard in the job (24).

The second part of this study in the weaving preparatory and weaving processes, showed the major cause in 51.3% of the accidents to be due to unsafe actions, and in 48.7% due to unsafe conditions (25).

.../.

The third part of the finishing processes revealed 54% of the accidents to be due to unsafe condition (16).

These three studies all point out to hazardous conditions as a leading major cause in accident causation.

Statistics have also been compiled to give an idea of how accidents are distributed over the different hours of a working day and how many accidents happen on each day of the week. Such information is very interesting, for it is often assumed that the general environment remains constant and that it is the "human factor" which is much more likely to be the cause of variations.

In a British study entitled 2000 accidents: A shop floor study of their causes (National Institute of Industrial psychology, 1971), 2367 accidents at work were analysed. They occured in four different types of factories over a period of two years. As a rule, it was found that more accidents occured in the morning than in the afternoon, with a peak time for accidents occurring after mid-morning. This was also the finding of Zetterman in his study of condition in Sweeden in the early 1950s (27).

.../

In a study based in the United Kingdom, it was found that local accident peaks occurred before breaks. Although this could have been due to fatigue, it could also have been the result of workers' speeding up production at these times in an effort to meet a target before the break. Furthermore, when people stopped work to tidy up at the end of the day, was either absent or very small (28).

As to the question of accident distribution over the days of the week, it appears that the highest accident rates are normally found on Mondays and the lowest on Thursdays and Fridays. One underlying factor in this distribution is the absence of workers. In many industrialised countries, absenteeism is always higher on Mondays than on other days of the week. This results in workers having to stand-in for absent colleagues and having to undertake unfamiliar jobs that day(29)

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Statistics showing the relation between the number of accidents and the age of the workers illustrate another interesting aspect of the influence of the "human factor". Recent figures from the United States have revealed that younger workers have more accidents than older workers, and that young male workers have about twice as many accidents as young female workers. One set of figures indicated that workers aged 18 - 22 made up 7.35 percent of the workforce but suffered 10.62 percent of the total number of accidents. Such workers, as well as being young, are new and have little experience of the job (30).

Every accident whatever trivial at first sight, should be investigated. For many years, only accidents causing serious injuries have been investigated and minor accidents have largely been ignored.

Early statistics on the subject show that one accident involving major injury happens for every 29 accidents resulting in minor injuries and for every 300 accidents which do not cause injury (i.e. " near accidents"). Some investigators give the ratio as 1:20 : 200, others quote much lower figures depending on the type of industry.

.../

In heavy industry, where there is theoretically more likelihood of sustaining a major injury, the ratio will be low. The opposite is true in light industry where the ratio of minor to major injuries may be 50 to 100 times higher (31).

Therefore, the study of "near accident" (incid hed light on the analysis of major ones.

PORT ACCIDENTS:

In Great Britain, in 1977, on docks, wharves and quays 27 percent of the total number of accidents were due to falls, and 26 percent occurred in handling goods (32).

Three returns prepared by the National Wage Earners' Sickness Insurance Fund showed the following figures in all French ports:

- With regard to the material elements connected with the accident: Objects being handled by manual methods constitute the most frequent source of accidents (32.8% in 1968, 34.96% in 1969). These are followed by accidents due to the place of activity and area of movement:

.../

18.5% in 1968 and 9.4% in 1969 for accidents not involving any fall to another level, and 9.6% in 1968 8.3% in 1969 for accidents involving a fall to another level, together these account for about 28% of accidents coming within this category.

Hoisting equipment and gear are still responsible for a very large number of accidents: 16.2% in 1968 and 15.2% in 1969, moreover these accidents are often very serious: in 1969, out of the 15 total accidents occurring in French Port were due to this cause.

With regard to the character of the injuries suffered, various forms of contusion are by far the most frequent: 51.4% of accidents in 1968 resulted in this kind of lesion.

With regard to the location of lesions, special attention is demanded by the frequency of injury to the hands (21.4% in 1968), to the trunk (20.8% in 1968) and to the lower limbs (17.3% in 1968). Foot injuries also remain very common (12.1% in 1968). (33).

A study of accidents in a naval dockyard , Singapore, 1955 and 1956, revealed causation of accidents to be 17.1% during handling stores, 7.8 % by falls, and 14.4% by machinery in 1955 and 8.7, 12.6 and 7.2 in 1956 respectively. The Singapore 1955 percentages of accidents caused by handling

.../

stores and machinery were of the same order as those given by the National Safety Council of U.S. and Taylor (34) in 1956. There was however a considerable reduction in the percentage of accidents due to handling stores and machinery, with a relative increase in those due to falls (34).

In the same study , the accident rates in 1956 varied considerably between the various departments of the dockyard. In several instances unexpected results were found. In four departments (construction, engineering, civil engineering, and naval stores) the number of eye accidents increased in 1956, accidents from falling and being struck by falling objects also increased in two departments.

The percentages due to handling stores or goods are much lower in Singapore than those under equivalent categories in the United Kingdom, but those under "struck by falling objects", using hand tools, and eye injuries are greater. Vernon (1936) quotes the 1928 and 1932 reports of the Chief Inspector of Factories (35) to show that eye injuries incurred in industry averaged 4.3% and 4.2% respectively of all reportable accidents, and also that the highest percentage in any one year was 8.3% (36) . The percentage of eye injuries over two years in Singapore amounted to nearly three times the highest percentage recorded in the United Kingdom.

.../

The same Singapore port study described accidents as affected by age and ethnic group.

Among Chiness and Indians, the accident rate increases to a peak in the second age group and falls steadily thereafter; in the Malays, the peak occurs in the 36 to 45 age group. In the Veterans of 56 years and more the rate is notably low for Chinese and Malays. Their rates based on an average of two years with very different accident records, are of course misleading in themselves but portray accurately the relation between the age groups.

They differ from the findings of Hewes (1921) who, dealing with 2891 male employees of a Connecticut silk mill, showed that the frequency of accidents was greater under 20 years of age but dwindled steadily thereafter (37). This was also the experience of Schmitt (1926) (38), but Brundage (1927) showed a comparatively steady frequency rate up to the age of 50 and then a fall (39).

McFarland (1957) quoted the records of an industrial physician of Ohio, that "50% of industrial accidents occurred in people under the age of 25, and that the rate for the 20 - 24 year group was more than twice that of the 40 - 44 age group " (40).

.../

Sutherland et al. (1950) show in both groups of factories the highest rates in the yougest age groups decreasing exponentially to a minimum over 55 years of age of between one-third and one-quarter the rates of those under 20 (41).

Kossoris (1948), however, agrees in showing that among 18000 factory workers the frequency of non-disabling injuries showed a steady decline from the 25 to 27 age group onwards (42),

King and Speakman's suggestion (1953) that the high rate in the younger age groups is largely due to inexperience does not agree with the findings here that those most affected were not the youngest, nor does the very low labour turnover in the dockyard support this suggestion (43). The other concepts of "general immaturity" and "less responsibility" remains for consideration but must apparently be counterbalanced by carelessness or over - confidence in the middle - age groups.

The accident frequency was highest on Monday and fell to its lowest level at mid-week, at a Naval dockyard in Singapore (13). This agrees with Factory B of Sutherland et al. (1950) for the first three days of the week (476,466, and 424 accidents) but not for the next two days (481 and 383). Sutherland's Factory A was different on all counts (41).

.../

Vernon (1918) showed that, with a 12 hour working day, accidents were most frequent on Mondays, sinking to a minimum on Fridays, with an increase once more on Saturdays, and related this to some extent to the consumption of alcohol (44). This factor would apply very little in Singapore.

The number of accidents rose to a peak between 8 and 10 a.m. and to a lesser ridge between 2 and 3 p.m. Ignoring the few accidents on a Sunday, in the six monrning of four and a half hours each (27 hours) 182 accidents were reported, while in the five afternoons (17½ hours) only 78 occurred in a Singapore Naval dockyard (13). Thus 70% of those accidents took place in the morning at a rate of 6.7 accidents per hour, and 30% in the afternoons at a rate of 4.5 accidents per hour.

Imbert (1904) stated that more accidents occur during the last two hours of the morning and in the afternoon spells of work (45). But most records of a committee of the British Association (Sargant Florence, 1916) show that accidents increase during the morning to reach a maximum in the last hour or hours but one. In the afternoon the peak period for accidents was around 3 p.m. (46)

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Vernon , Bedford, and Warner (1931) also showed that miners attained maximum accident frequency in the last hour of full work at low temperature, but when the temperature was high, accidents reached the peak in the last hour but one. (44). In the Singapore dockyard, when temperatures are high, the second peak of accident frequency was reached in the penultimate hour of afternoon work.

The two factories investigated by Sutherland (1950) differed in their hours of work but the peak periods for accidents were in both instances between 8 and 9 a.m and 3 and 4. p.m. Sutherland also found that the rate of reporting accidents was from 30 to 40% lower in the afternoon than in the morning.

Comparision of the 1966 " three-day " industrial injuries which occurred during the first half of 1967 in the port of London in the shipbuilding and dock industries, shows that workers in the latter are more exposed to injuries in the trunk spine and hand and only the eye was more valunerable in shipbuilding personnel. (11).

Analysis of the three day injuries in registered dockworkers in the port of london shows that handling was the most common operational hazard but the direct trauma

.../

was responsible for much of the injury. The relationship between trauma arising extrinsically and intrinsically is of particular significance in the aetiology and prevention of back injuries (11).

This brief introduction to the size of the problem contains a number of statistics. Many would dispute them because a great number of accidents are never reported and many industrial diseases go unrecognised. However, as was stated earlier, one fact is indisputable - the world is paying a heavy price for accidents in terms of both human suffering and economic waste.

CHAPTER III. METHODOLOGY.

1. OBJECTIVE.

The overall objective of this study is to have knowledge on the occurrence and determinants of accidents in Assab Port and provide information useful for the planning of preventive strategies.

The specific objectives are:-

(a) To determine the incidence density of all causes of accidents in Assab port.

(b) To describe the rate of accidents by age, sex, educational status, location of accident , day of the week, time of the day, health facility attended, experience of work, worker category, department, work site, title of worker and number of illness episodes.

(c) To describe the percentage distribution of accidents by the Nature of Injury, Part of body affected, source of Injury, Accident Type, Major causes and severity.

(d) To describe the environmental health and safety methods existing in the port.

(e) To describe cost of accidents in general and,

(f) To plan preventive strategies for accident in the port.

In addition, several hypothesis of association with the occurrence of accidents are to be tested.

H1. That the rate of occurrence of accidents is inversely related to the educational status of the worker.

H3. That accidents occur more frequently in the night shift than the day shift.

H4. That the rate of occurrence of accidents is directly related to the number of sickness episodes in the patient within the last one year.

H5. That accidents occur more frequently in those who does not have safety training than those with safety training.

2. DESIGN.

A. Preparatory Phase.

Initial discussions were held with the managers of the Marine Transport Authority and the Port administration on the relevance of the study and the supports expected from them. A notification was given in a written form from the port manager to Heads of departments, sections and foremen to facilitate the study and transfer of patients to the port clinic and Assab hospital.

B. TYPE OF THE STUDY.

A case - Control study was designed to determine the occurrence and determinants of accidents among 5930 port workers at risk in Assab, Ethiopia.

Newly diagnosed "INCIDENT" patients from October 16, 1987 to December 9, 1987 (a total of 55 days) who sought medical attention for injuries from the four departments at risk were taken as CASES.

Matching method was used to select the CONTROLS. Each case was paired to one control on the variables of worker's category, payment methods, department, work site and worker's occupation. When more than one control was encountered that could match with the case, a Lottery method was used to identify only one control.

C. POPULATION.

- BACKGROUND INFORMATION.

Assab is one of the Awrajas in northern Ethiopia with an area of 33,200 square kilometers. The Awraja borders with:

Eriteria to the North:

Wollo and Tigrie to the West;

The Red Sea to the East and

Djibouti to the South.

The North -West border of the Awraga is formed by the Denakil Depression: which is 117 meters below sea level.

The total awraja population is 113,738. Out of this - 38,442 are residents of Assab town.

For most of the year, the Awraja is very hot and annual temperature ranges between 27 and 44 degrees celsius.

The relative humidity ranges between 40 and 80 percent. Due to the high temperature about 50 percent of the daily labourers have heat exhaustion every year, and about 1 percent of the daily labourers have heat stroke during the hot seasons. (June-October).

About 8000 (20.8 percent of the town population) are exposed to different environmental and occupational health hazards which include:

- Different injuries;
- Heat exhaustion and stroke;
- Exposure to vibration;
- Occupational skin diseases;
- Work hazards related to working high above the ground;
- Exposure to wood dust;
- Exposure to lead;
- Loud noise exposure as a result of turbile Power plant;
- Exposure to caustic and acidic products;
- Exposure to Asphalt and;
- Exposure to different kinds of hydrocarbons.

THE STUDY POPULATION.

Information obtained from employment list of the Electronic data processing section in the port authority shows some 6500 persons are employed in the port of Assab, but of

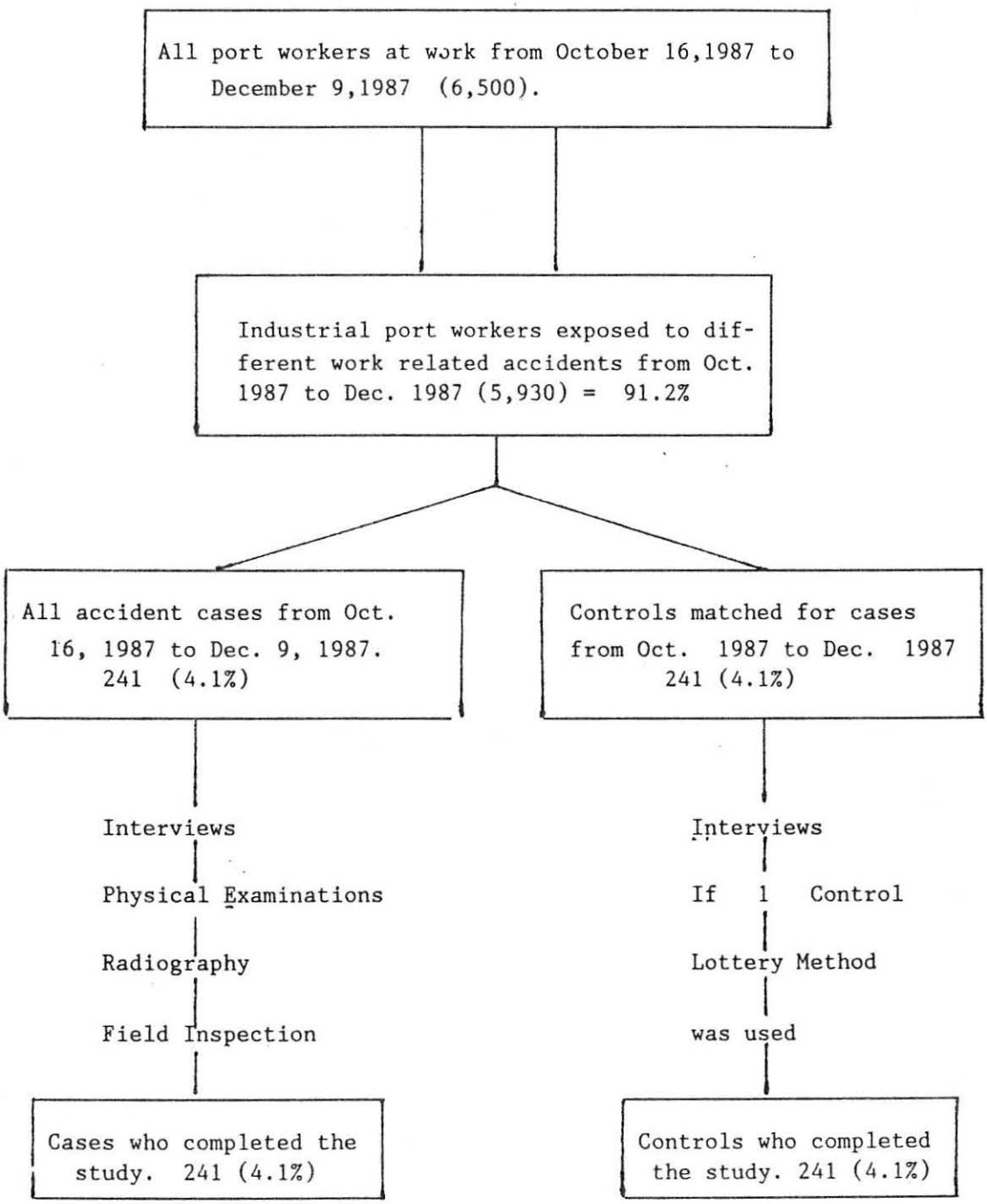
these 570 (8.8%) are listed as "non-industrial", or are employed on work that is unlikely to bring them into coontact with industrial hazards. The remainder 5,930 (91.2%) were on the books of the four departments principally concerned with industrial work. The 5,930 was made up of 5,725 (95.4%) males and 205 (3.4%) females. The four industrial departments are Operation (with 3,220 workers at risk), Engineering (with 1,786 workers at risk), Harbour master (with 85 workers at risk), and Haleb project (with 42 workers at risk). Although the port club (with 42 workers at risk) is not labelled as a department, like all the departments it is accounted to the port manager.

The non-industrial departments which were excluded from the study are Administration and Finance.

All newly diagnosed accident cases and their matched controls from October 16, 1987 to December 9, 1987 were taken from the 5,930 port workers at risk of encountering accidents. Repeat accidents not being seen in the short study time.

The investigation limited itself to the residents of the town of Assab and Haleb island which is located 90 Kilometers from the town of Assab. Haleb island is one of the four departments in the port authority where a shipyard factory under construction is placed. The study design for accidents in the Assab port is presented in Figure 6.

FIGURE 6. STUDY DESIGN OF ACCIDENTS IN ASSAB PORT:



D. The Research Instruments.

- The Questionaire and Data Entry Form

The questionaire was constructed for CASES with information on:

(i) Sociodemographic variables

Age, sex, educational status, years of service, time on present job, worker category, Payment method, department, work site, Worker's occupation, safety training, sick days & sickness episodes.

(ii) Accident variables.

Place of accident, Date of accident, Day of week accident occurred, Time of accident, Time of accident since beginning of work, Health facility attended, Nature of injury, Part of body affected, source of injury, Accident type, Major causes by hazardous conditions and unsafe acts, severity of injury and cost of accident.

The questionaire constructed for the controls included all the informations outlined for CASES except for injury related questions.

The questionaire was then categorized and coded for analysis. The data entry form and the coding manuals used for both cases and controls were listed in the annexes.

To complete the questionaire, the American National Standard Method of Recording Basic Facts relating to the nature and accurrence of work Injuries (ANSI) classification was used to categorize the different accidents (21). The ANSI CLASSFICATION is in the annexes.

- Field Inspection.

Field inspection was done to every accident case and the environmental conditions surrounding the accident was noted. As most of the accidents took place in the compound of the port, approval for field inspection and to take photographs when necessary was secured from the port authority. In addition a port entry permit was issued to the four nurses and one medical doctor to do the inspection.

During the field inspection the idea of the formen and supervisors about the cause of the accident was asked.

E. Recruitment and Training.

Six nurses were recruited from the Assab hospital for their good personality, interest and approach to patients. All of the interviewers were males with different ethnicity. Their age ranges between 25 and 40. Five years work as a health personnel in the Awraja was the minimum. 4 out of 6 were involved in collection of data for the Awraja nutrition survey and health profile.

The seventh person who was the principal investigator of the study is an M.D. a one week training to the interviewers was given by the principal investigator. The training involved:-

- An orientation to the study goals and familiarity with the questionaire and all its subtleties.
- Identifying cases and controls.
- Principles of random selection and matching.
- Interviewing techniques.
- On the use of the American National Standard Method of Recording Basic Facts- relating to the nature and

occurrence of work injuries (ANSI)

- On points that should be asked and looked in field inspection and,
- The importance of the confidentiality and safety of the information entrusted to them by Patients, Physicians, and and relatives.

After arrangements were done with transport and other administrative supports, two nurses were assigned fulltime in each of the Haleb and Assab port clinics and in Assab Hospital study in the three health institutions persistently. The study was conducted 24 hours a day and seven days a week with a schedule prepared together by the principal investigator and interviewers.

F. PILOTE PHASE.

The questionaire and the interviewers were tested on a pilot study for one week before the full scale study was started. The questionaire was administered to 25 cases and the result suggested that the question about alcohol not to be practical. Modification of questionaire and additional orientation was done to the interviewers.

3. DEFINITIONS.

Accidental injury is defined by the WHO as " an unpremediated event resulting in a recognizable injury" (47). The criteria for CASE selection in this study were based on this definition as well as the consideration that any injury whatever trivial and whether caused a restriction of work to the individual or not were included.

The selection of controls was stated earlier.

In this particular study the "port club" is taken as one department and definitions are listed.

"LITERATE" is defined as those who can read and write Amharic.

"ILLITERATE" are those who does not fulfil the definition described for literates.

"Primary School" includes grades 1 to 6.

"Secondary School" includes grades 7 to 12.

Above grade 12 are included in the Universities, junior and vocational colleges.

"Skilled" is defined as trained or experienced worker.

"Apprentice" is a learner with a reduced salary and who has agreed to work for a certain years in return for being taught.

"Unskilled" is a worker with no training and experience.

"DOCK" includes all sections under operation department and shore-crane technique of the department of civil engineering

"Construction Area" includes all the civil engineering department excluding shore-crane technique and the department of Haleb project.

4. COLLECTION OF DATA.

At first the general nature and purpose of the study, the benefits and his or her right not to enter into the study was explained to the cases and controls by the interviewers. The participant's name was replaced by a code to help guarantee that the information collected from the individual was kept confidential.

Only cases and controls with obtained consent were admitted to the study. Then filling of the questionare and field inspection were done by the trained interviewers.

The compliance of the interviewers with established standards was assured through regular monitoring during the conduct of the study. In view of the importance of their work, interviewers were carefully supervised and, at times, "refreshed" through special sessions by the principal investigator.

At the same time the principal investigator collected data from the Electronic data processing unit on the man-hours worked within the study period (55 days) by categories of Age, sex, educational status, shifts, work experience, worker category, payment method, department, work site, and worker's occupation which were used to calculate accident rates per 100,000 man-hour worked.

From the same unit the number of workers by categories stated for man-hours worked were obtained. It was used to calculate accidents per 1000 workers which is used in most accident studies.

5. HANDLING OF DATA.

After editing the data on the data entry form, it was entered on a d base III system diskette with a computer. Again the data was editted after entering to the diskette and a back up, copy was made. Different codes were given for both cases and controls.

6. ANALYSIS OF THE DATA.

The data was analyzed with SPSS-X2 statistical package by orderly applying analytic methods, beginning with simple descriptive statistical displays and summaries, then matched analysis between the cases and controls were made by the aid of HP-11C calculator. Finally a "Mantel-Haenszel" method of adjustment for confounding variables were applied to the data after a full exploration has been conducted using simple techniques.

- Descriptive part.

In the descriptive part of the study, Accident rates per 1,000 workers by Age, sex , educational status, experience of work, worker category, Payment method, department, work site and title of worker were calculated and a test of significance (X^2) were done for the different variable to see whether the difference in each category of the variables was significant or not.

In addition, the percentage distribution of accidents by their location, day of the week, hours since beginning of work, health facility attended and experience within the same work category were described.

The percentages of working days lost and sickness episodes in the last one year were also calculated.

The percentage distribution of port accidents by the nature of injury, part of body affected, source of injury, types, major causes and severity were computed. Finally on the descriptive analysis break-up of expenditure involved in port accident were analyzed.

- Analytic Part.

Point Estimation of the Odds Ratio.

To ensure that comparison between cases and controls were not biased a two step process was used to control for confounding.

(1) matched design followed by
(2) matched analysis.

As will be recalled in the design, one control was matched per case on variables of worker category, payment method, department, work site, and worker's occupation. The analysis of this study retained the pairing of cases and controls.

Table 7. Frequency of Exposure Among N. Case - Control Pairs.

	CONTROL +	CONTROL −	TOTAL
Case +	A	B	A + B
Case −	C	D	C + D
TOTAL	A + C	B + D	N

1. Exposed (+) , non -exposed (-).

First all the variables were dichotomized denoting the presence or absence of exposure by + or - respectively, the four outcomes for each pair (case, control) were : (++), (+-), (-+), and (- -). The term A denoted the number of pairs (++) in which both the case and the control were exposed to the variable. The term B denoted the number of pairs (+-) in which only the case was exposed, the term C denoted (-+) in which only the control was exposed and the term D denoted (--) in which

both the cases and the controls were not exposed. The marginal totals A+B and C+D represent respectively the numbers of exposed and unexposed cases, whereas the marginal totals A +C and B+D represent the corresponding numbers of exposed and unexposed controls. The term N denoted the total number of pairs, so that the total number of cases and controls is 2N.

In a comparison of the proportion of exposed cases $(A+B)/N$ versus the proportion of exposed controls $(A+C)/N$, the case-control differene is simply $(B-C)/N$.

Thus odds ratio is calculated by the formula (B/C).

- Approximate Tests of significance and Confidence Intervals.

Since the analysis of the study data is a matched one, the McNemar's (1947) test of significance was used to calculate the $X^2(50)$, which is $X^2 = (|B-C|-1)^2 / (B+C)$.

An approximate confidence interval for the odds ratio was based on the above equation. Therefore the following two equations were used to determine the confidence limits.

$Pu = [b+(b^2-4ac)^{\frac{1}{2}} [/ 2a$

$Pl = [d- (d^2-4ae)^{\frac{1}{2}}[/ 2a$

$\Psi_l = P_l / 4-Pl).$

$\Psi_u = {}^{P}u/U-Pu).$

After the simplest analysis was done considering exposure to be dichotomous, the different exposure levels were analyzed by a dose-response method using the extended Mantel - Haenszel procedure by regarding each pair as a separate stratum. At the same time test of significance for trend was done for each variable which had a character of dose response.

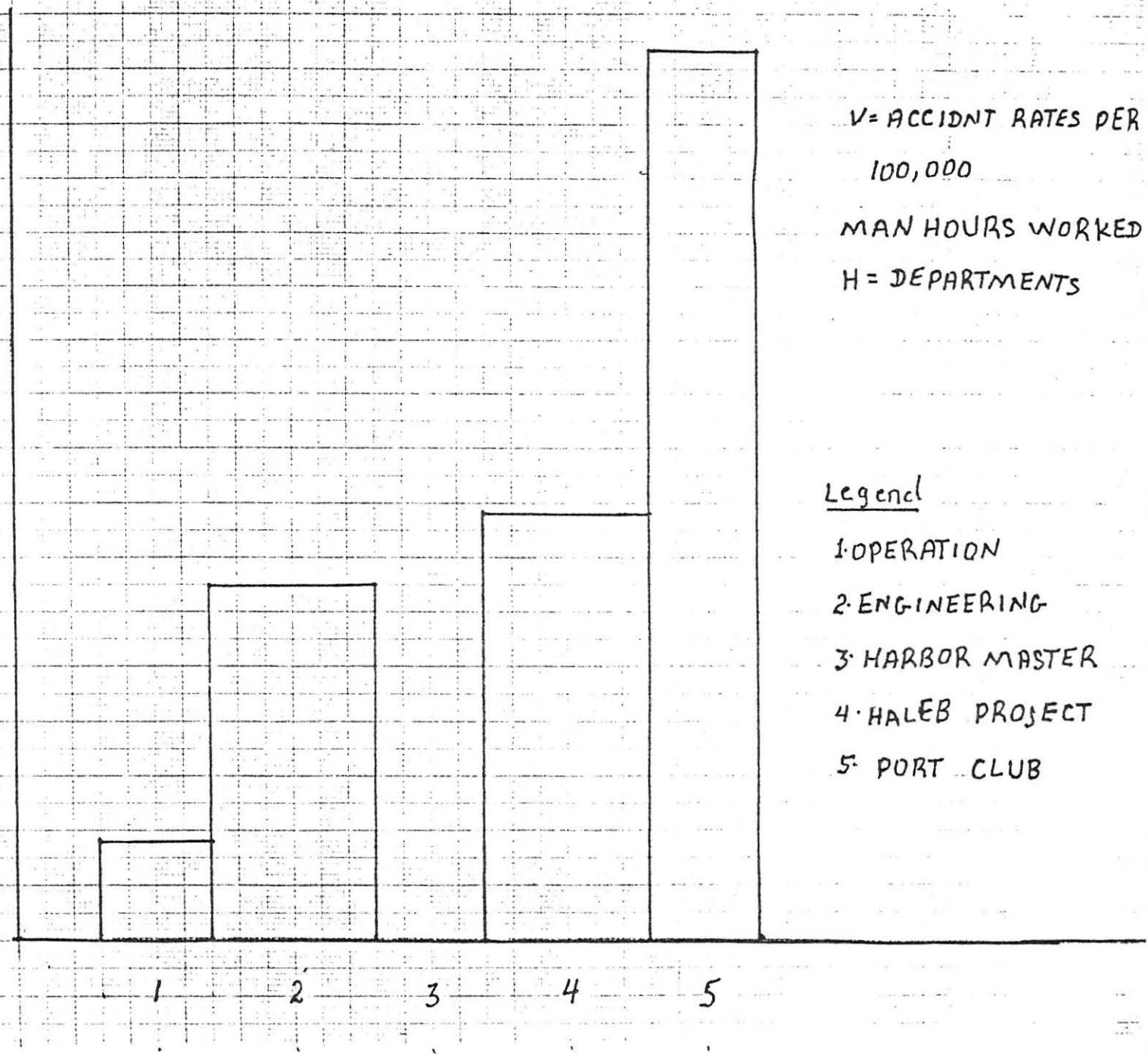


Figure 7 ACCIDENT RATES
BY DEPARTMET INVOLVED
ASSAB PORT 1987

As can be seen from table 9, maximum accident rate is observed in the department of port club (32.6/100,000 man hours worked, 166.7 /1,000 workers at risk and 8.3/ 1,00 employee-months). No accident was encountered in the department of "Harbout master".

B. RATES OF ACCIDENTS WITH BASIC SOCIO- DEMOGRAPHIC DATA.

Table 9 and Figure 8, shows the rate of accidents according to the age of the workers involved. Maximum rate of accidents were observed in case of young (18-24 years of age group) workers, being (25.8/100,000 man-hours worked, 130-2/1,000 exposed workers or 6.5/100 employee - months).

TABLE 9. RATE OF ACCIDENTS BY AGE INVOLVED! Assab port, 1967.

Age	Workers at risk	Man-hours worked	RATE OF ACCIDENTS			
			Per 100,000 man hours worked	Per 100 employees months	1,000 exposed workers	X^2
18-24	622	314,217	25.8	6.51	130.2 (81)	2
25-30	1,136	569,751	10.5	2.64	52.8 (60)	N.S
31-35	1,380	684,026	5.0	1.23	24.6 (34)	N.S
36-40	1,113	540,994	6.1	1.48	29.6 (33)	N.S
41-45	847	414,632	4.1	1.01	20.1 (17)	N.S
46-50	549	268,024	2.2	0.55	10.9 (6)	N.S
51-55	283	141,061.	6.4	1.59	31.8 (9)	N.S
Overall	5,930	2,932,705	8.2	2.03	40.6 (240)	
Overall significance:			(P< 0.001			

1: Note : One accident encountered at the age of 17 was omitted because of the class interval.

2:P value less than 0.001

N.S = Not significant.

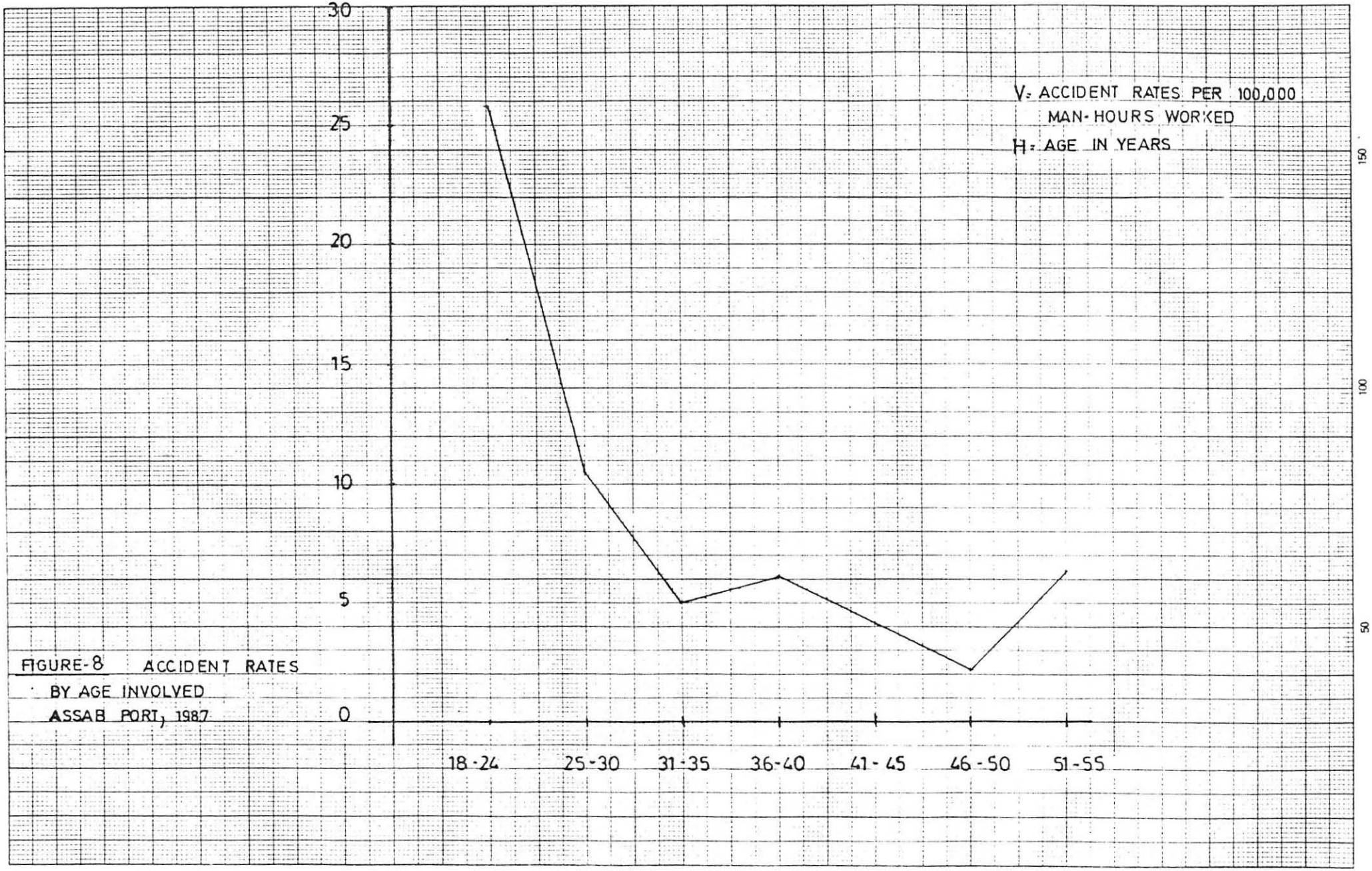


FIGURE-8 ACCIDENT RATES
BY AGE INVOLVED
ASSAB PORT, 1987

The differene in the rate of accidents per 1,000 workers at risk among the age categories is statistically significant (P< 0.001). The significance of the resulting chi-square test derives mainly from the discrepancy in the age category 18-24.

Distribution of the rate of accidents by sex is presented in Table 10 and Figure 9.

T a b l e 10. Rate of accidents by sex involved. Assab port, 1987.

Sex	Exposed workers	Man-hour worked	Rate of accidents			X^2
			Per 100,000 man hours worked	Per 100 employee months	per 1,000 exposed workers	
Male	5,725	2,856,930	8.3	2.07	41.4 (237)	N.S
Female	205	75,775	5.3	0.98	19.5 (4)	N.S
Overall	5,930	2,932,705	8.2	2.03	40.6 (241)	

Overall significance = P> 0.05

N.S = Not significant.

From the table, it appears that there is no difference in the rate of accidents between males and females. The diffeence per 1,000 workers at risk is not statistically significant at 1 d.f. (P> o.05).

Table 11 and Figure 10. shows the rate of accidents by the worker's ever attended educational status. From the table maximum accident rate was observed in the educational status category "secondary school" (22.8/100,000 man-hours worked,124.2/1,000 workers at risk or 6.21/100 employee-months).

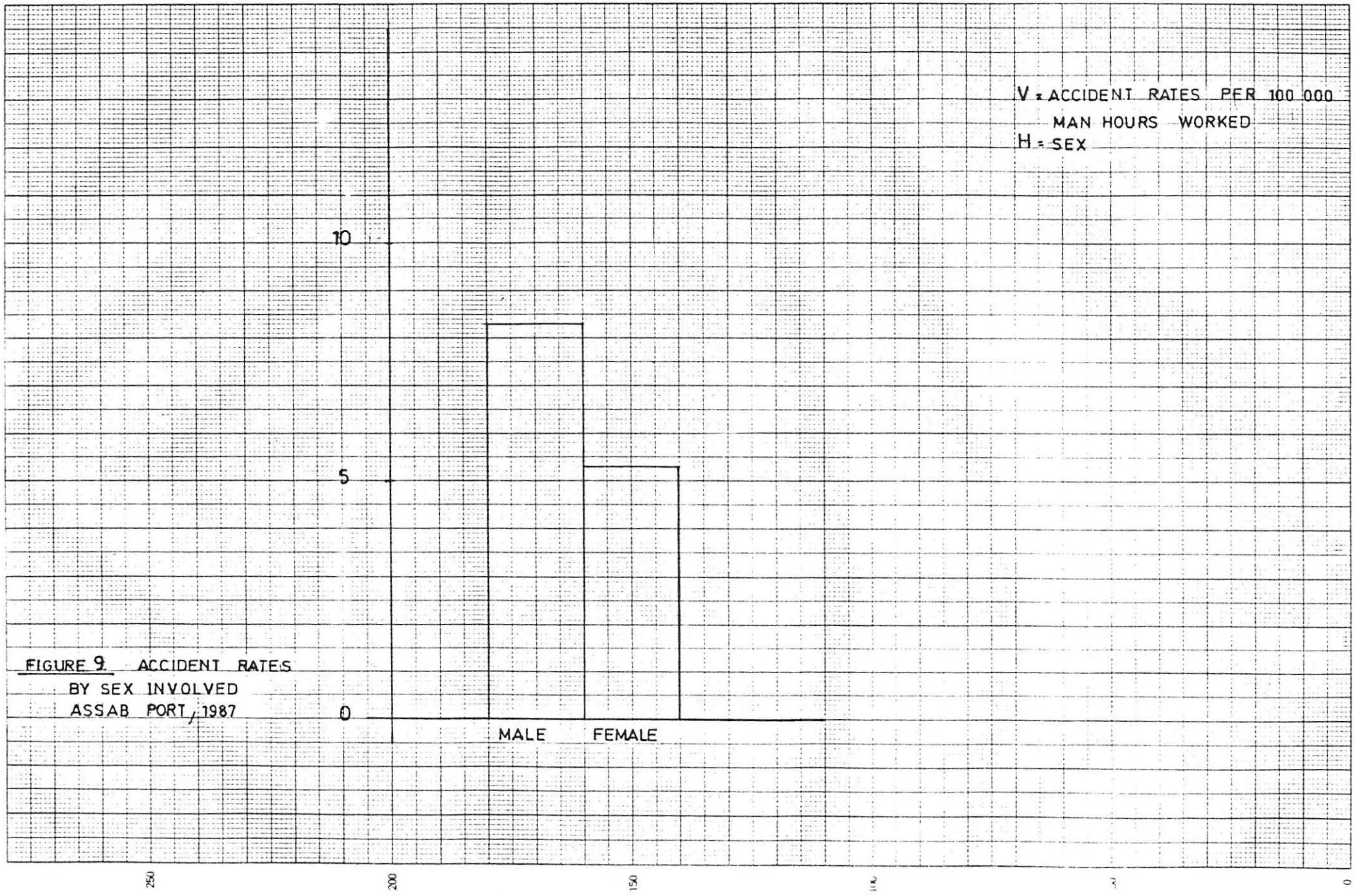


FIGURE 9 ACCIDENT RATES BY SEX INVOLVED ASSAB PORT, 1987

Table 11. Rate of Accidents by ever attended educational -status., Issas, 1987

Educational status	Workers exposed	Man-hours worked	Rate of accidents			
			per 100,000 man-hours worked	Per 100 employee months	per 1,000 workers	X^2
Illiterate	979	475,276	4.4	1.07	21.4 (21)	N.S
Literate	2,891	1,394,489	3.4	0.81	16.2 (47)	1
Primary - school	1,210	598,967	12.7	3.14	62.8 (76)	1
Secondary-School	765	416,709	22.8	6.21	124.2 (95)	1
Above grade 12	85	47,264	4.2	1.18	23.5 (2)	N.S
Overall	5,930	2,932,705	8.2	2.03	40.6 (241)	

Overall Significance = (P< 0.001)

1 = P value less than 0.001
N.S = not significant.

In table 12 and Figure 11, rates of accidents by Category of worker is displayed.

Table 12. Rate of accidents by category of worker. Issas Port, 1987.

Worker Category	Workers exposed	Man-hours worked	Rate of accidents			
			per 100,000 man-hours	per 100 employee months	per 1,000 workers	X^2
Skilled	1,885	1,007,209	6.2	1.65	32.9 (62)	N.S
Unskilled	3,889	1,847,890	9.4	2.24	44.7 (174)	N.S
Apprentice	156	77,606	6.4	1.61	32.1 (5)	N.S
Overall	5,930	2,932,705	8.2	2.03	40.6 (241)	

Overall significance (P> 0.05)

N.S. Not significant.

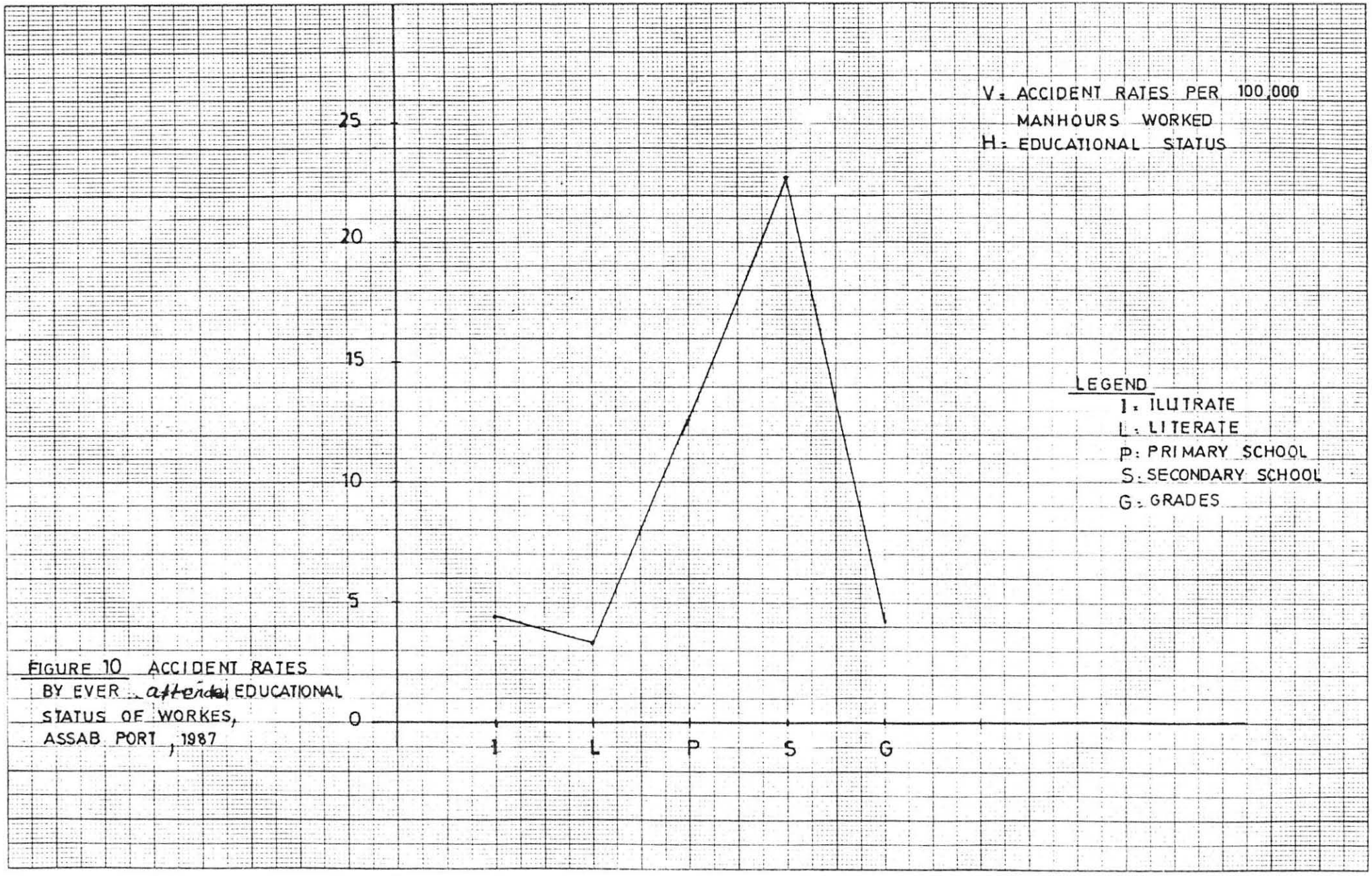


FIGURE 10 ACCIDENT RATES BY EVER ~~attended~~ EDUCATIONAL STATUS OF WORKES, ASSAB PORT, 1987

The difference in the rate of accidents per 1,000 exposed workers among the group by educational status is statistically significant ($P<0.001$). The significance of the resulting chi-square test is derived mainly from the discrepancy in the category of "secondary school".

Proof of HI does not correlate with the finding above and could possible be due to the short study period and small number of cases.

From Table 12, the difference in the rate of accidents per 1,000 workers at risk among the categories of the workers is not statistically significant.

Table 13. Rate of accidents by payment method, Assab port, 1987.

Payment method	Workers exposed	Man-hour worked	Rate Of Accidents			
			per 100,000 man-hour	per 100 employee months.	per 1,000 workers	X^2
Piece-work	719	345,120	9	2.16	43.1 (31)	N.S
Time-rate	3,967	1,903,094	9.7	2.32	46.4 (184)	N.S
Salary	1,244	684,491	3.8	1.05	20.9 (26)	1
Overall	5,930	2,932,705	8.2	2.03	40.6 (241)	
Overall Significance				(P< 0.01)		

1: P value less than o.01
N.S. Not significant.

The highest rate of accidents was observed among the worker's payment method "Time rate". The difference in the rate of accident per 1,000 workers at risk among the worker's payment method is statistically significant (P< o.01).

In table 14 and Figure 13, the highest rate of accidents was observed in the worker's job title "Electrician, Welder, Plumber, and Carpenter" with a rate of 16.7 accidents per 100,000 man-hour worked, 88.3 per 1,000 workers at rate or 4.42 per 100 employee-months.

The difference in the rate of accidents per 1,000 workers at risk among the workers by their job title is statistically significant (P< 0.01). The significance of the resulting chi-square is mainly derived from the discrepancy in the job title group classified as " Electrician, Welder, Plumber, and Carpenter".

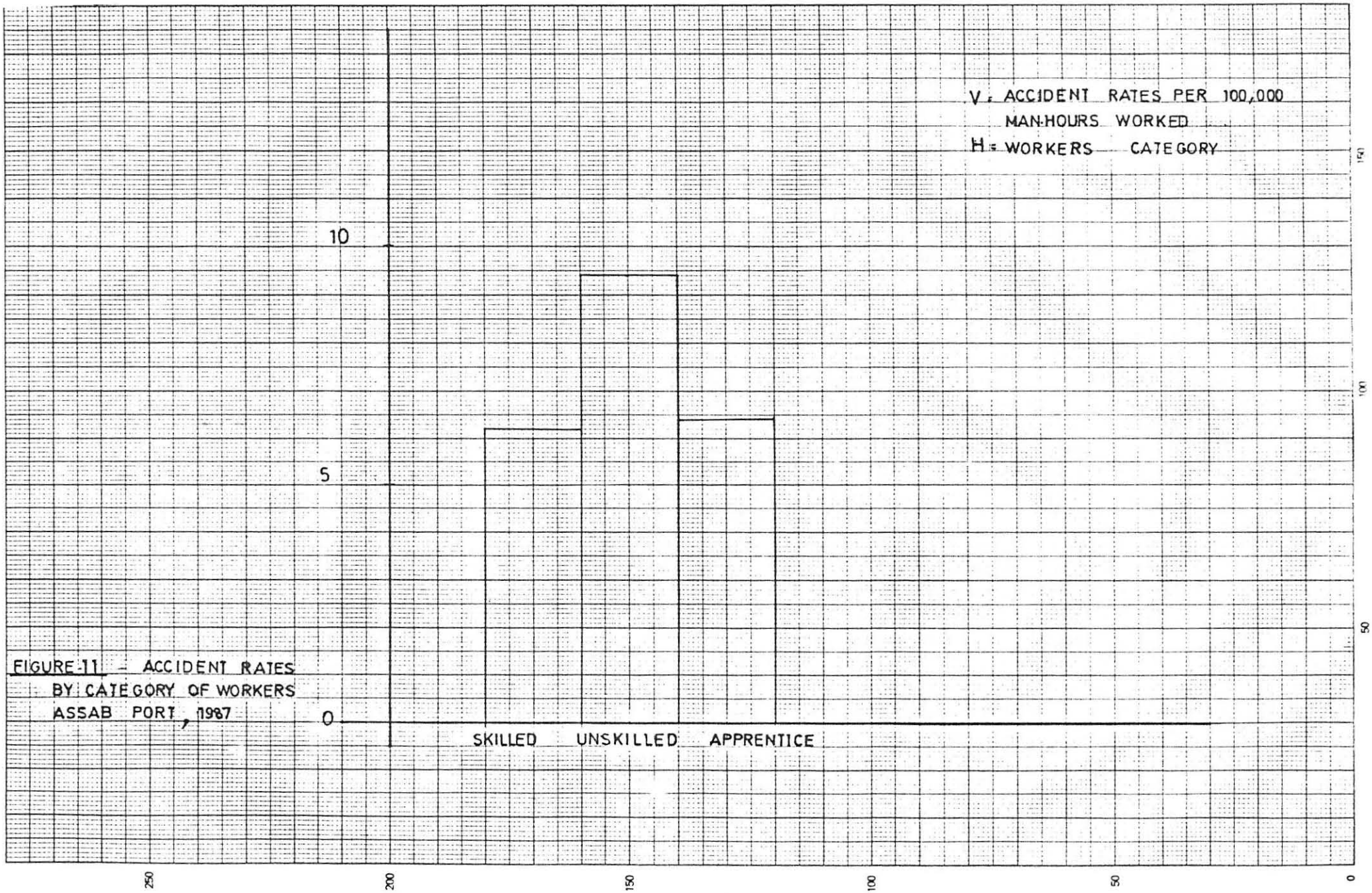


FIGURE 11 - ACCIDENT RATES BY CATEGORY OF WORKERS ASSAB PORT, 1987

Table 14 . Rate of accidents by the worker's job title. Assab port, 1987.

Job Title	Workers	Man-hours	Rate of accidents			
			Per 100,000	Per 100 employee months	Per 1,000 exposed workers	X^2
Daily labourer	3,889	1,847,890	9.1	2.16	43.2 (168)	N.S
Clerk of different types.	295	176,755	5.1	1.53	30.5 (9)	N.S.
Mechanic and machnist	212	121,243	4.1	1.18	23.6 (5)	N.S
Operators of different Machines	426	216,710	3.7	0.94	18.8 (8)	N.S
Seamen	85	41,077	0	0	0 (0)	N.S
Foremen and shift coordinators	234	135,983	4.4	1.28	25.6 (6)	N.S
Electrician, Welder, plumber, and carpenter	433	215,946	16.7	4.16	83.1 (36)	1
Others	356	177,101	5.1	1.27	25.3 (9)	N.S
Overall	5,930	2,932,705	8.2	2.03	40.6 (241)	
Overall Significance :				(P< 0.01)		

1: P value less than 0.01.

N.S= Not significant.

Others = Apprentice, drivers and Port Policemen.

C.PLACE OF OCCURRENCE OF ACCIDENTS.

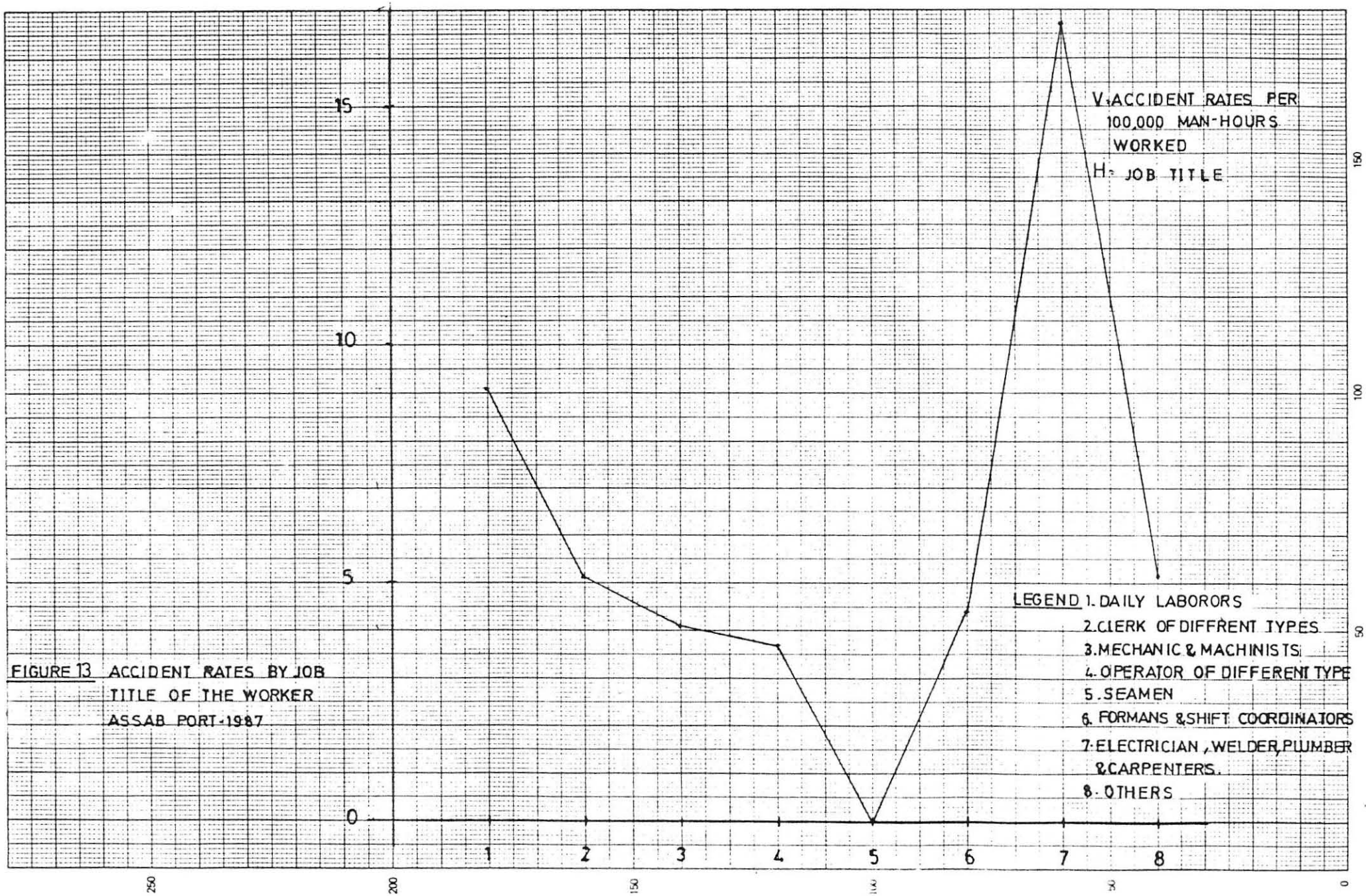


FIGURE 13 ACCIDENT RATES BY JOB TITLE OF THE WORKER ASSAB PORT-1987

Table 15 and Figure 14 shows the % distribution of accidents by their place of occurrence in the port.

Table 15 . % of accidents by their place of occurrence. Assab Port, 1987

Place of occurrence of accident	Number of accidents	Percent
Dock	55	22.8
Construction area	149	61.8
Power Station	9	3.7
Garage	15	6.2
Wood Work	4	1.7
Port -Club	9	3.7
Total	241	100

The place of occurrence for 61.8 percent of the accidents in the port is in the construction area.

D. DAYS AND TIMES OF ACCIDENT OCCURRENCE.

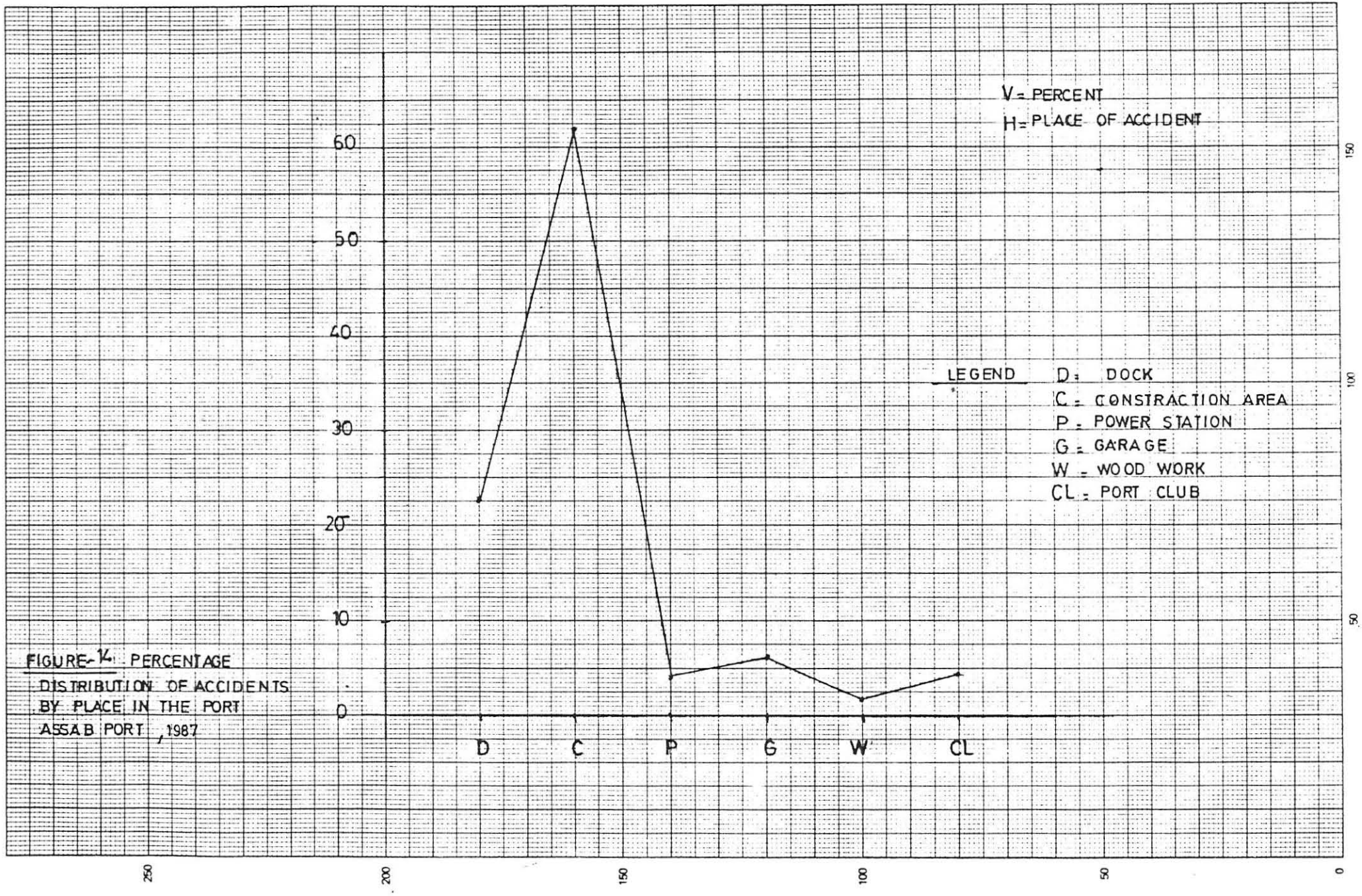


FIGURE-14 PERCENTAGE DISTRIBUTION OF ACCIDENTS BY PLACE IN THE PORT ASSAB PORT, 1987

Table 16 and Figure 15 shows the distribution of accidents by the day of theweek.

TABLE 16. Accidents by the day of the week, Assab Port, 1987

Day of Occurrence	No. of accidents	% of Total
Monday	47	19.5
Tuesday	31	12.9
Wednesday	42	17.4
Thursday	28	11.6
Friday	36	14.9
Saturday	44	18.3
Sunday	13	5.4
Total	241	100

The accident frequency was highest on Monday, thereafter it drops on Tuesday and picks up on Wednesday and again drops on Thursday and Friday and rises on Saturday.

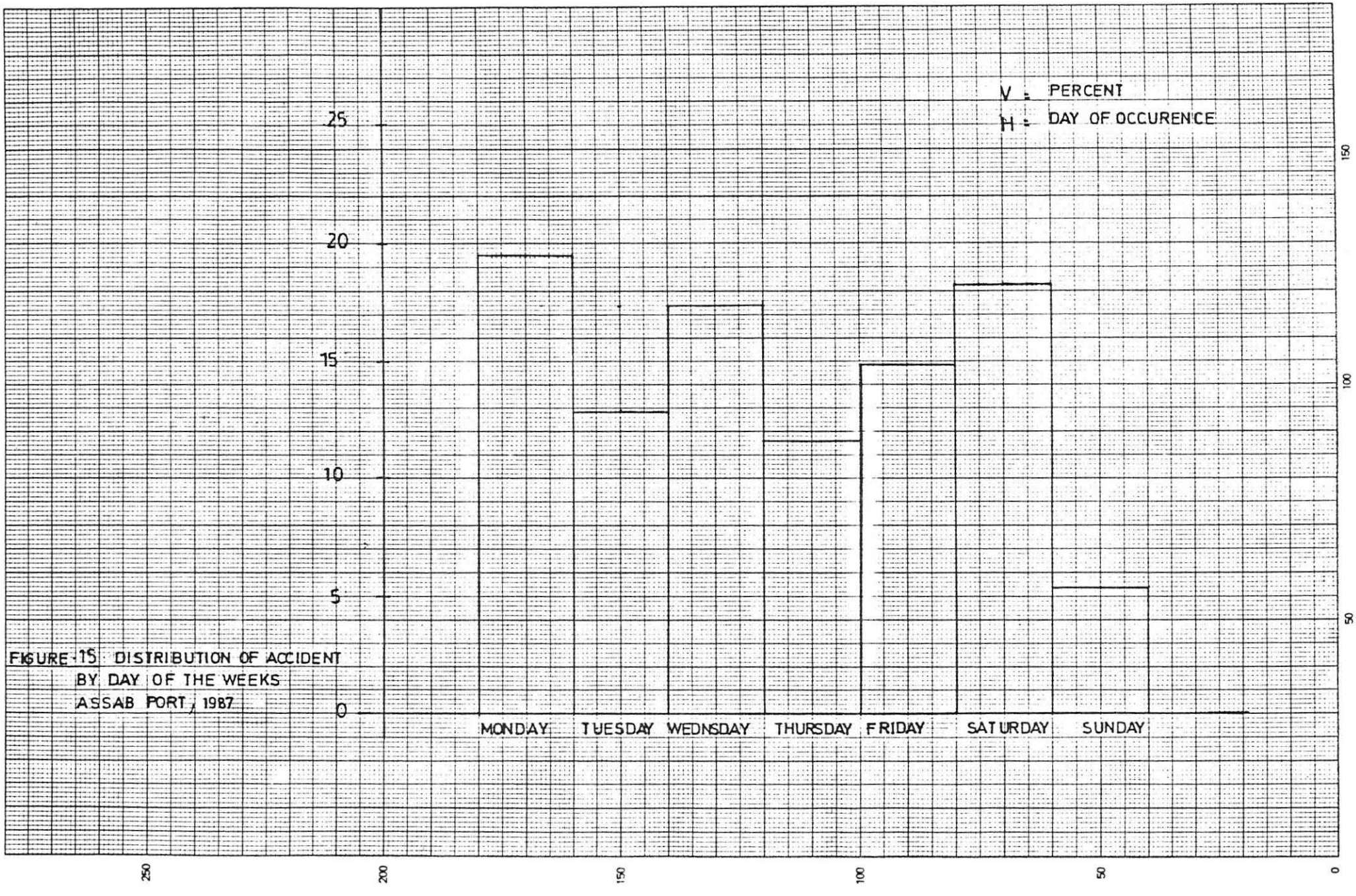


FIGURE-15 DISTRIBUTION OF ACCIDENT BY DAY OF THE WEEKS ASSAB PORT, 1987

TABLE 17. RATES OF ACCIDENTS BY SHIFT OF THE DAY. Assab Port, 1987.

Shift of Accident	Workers Exposed	Man-hour worked	Rate of accidents			
			per 100,000 man-hour	per 100 employee months	per 1,000 workers	X^2
First	2,611	1,354,973	9.7	2.51	50.2 (131)	
Second	1,706	809,391	10.6	2.52	50.4 (86)	N.S
Third	1,613	768,341	3.1	0.75	14.9 (24)	*
Overall	5,930	2,932,705	8.2	2.03	(40.6 (241)	
Overall Significance					(P< 0.001)	

* = Statistically significant

N.S = Not significant

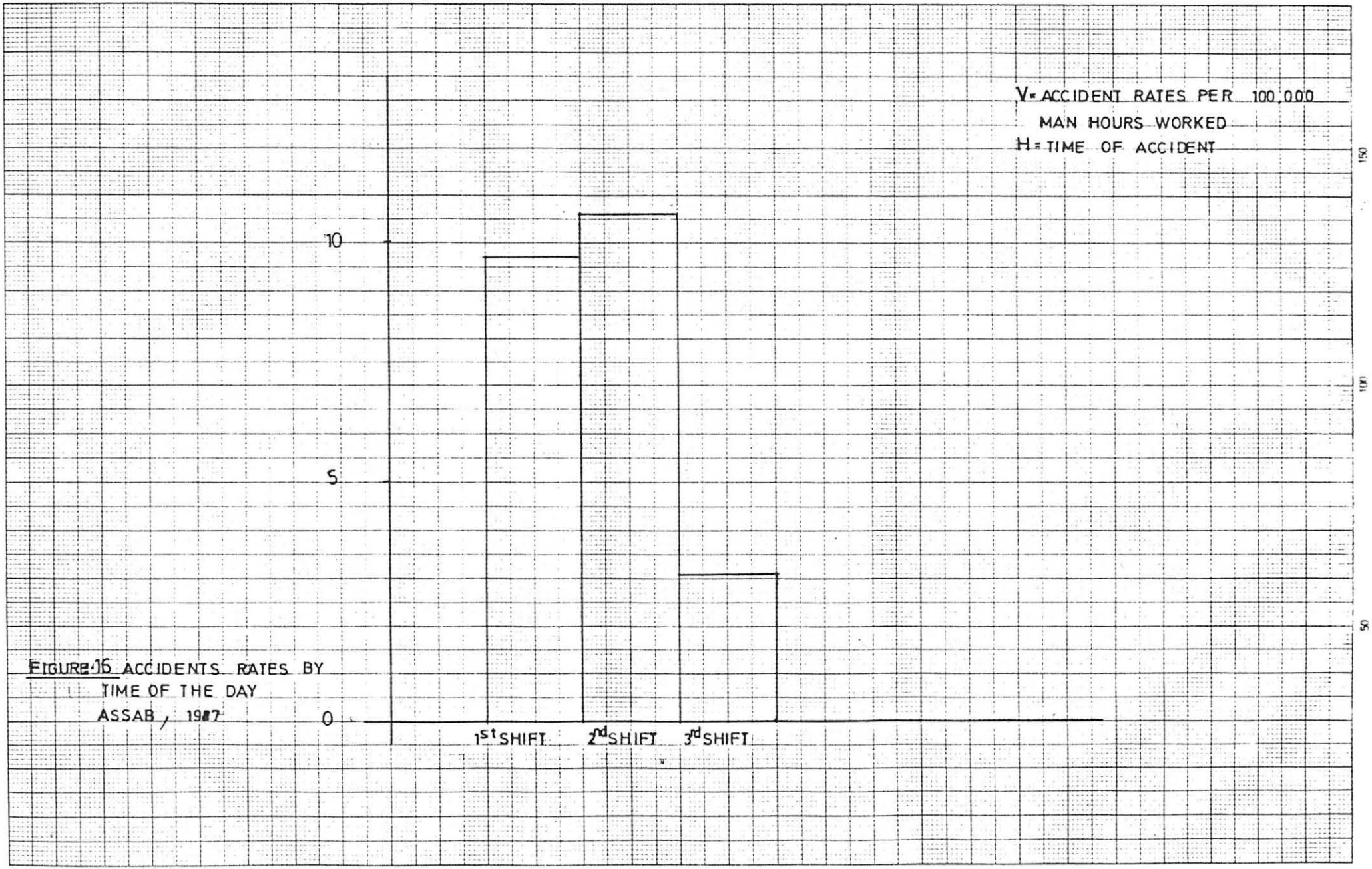


FIGURE 16 ACCIDENTS RATES BY TIME OF THE DAY ASSAB, 1967

The rate of the accidents are higher in the day shift (first and second) than the nigh shift ($P < 0.001$)

Table 18. % of accident time since beginning of work. Assab port, 1987

Hours	Number of accidents	Per cent
0	11	4.6
1	48	20.1
2	47	19.7
3	43	19.1
4	41	17.2
5	36	15.1
6	7	2.9
7	5	2.1
TOTAL	238	100

In the table above, three cases with accidents which occurred 9,9, and 11 hours since beginning of work were omitted in the table, because the percentage of workers in this group could not be known.

By taking 100 percent of workers in the regular shift, the majority of the accidents occurred 1 and 2 hours since the beginning of work.

E. THE NATURE OF INJURIES.

Table 19 and Figure 18 shows the percentage distribution of accidents by their nature. From the table one can see that 60.6 percent of the injuries are cut, laceration, and puncture (open wound) by their nature.

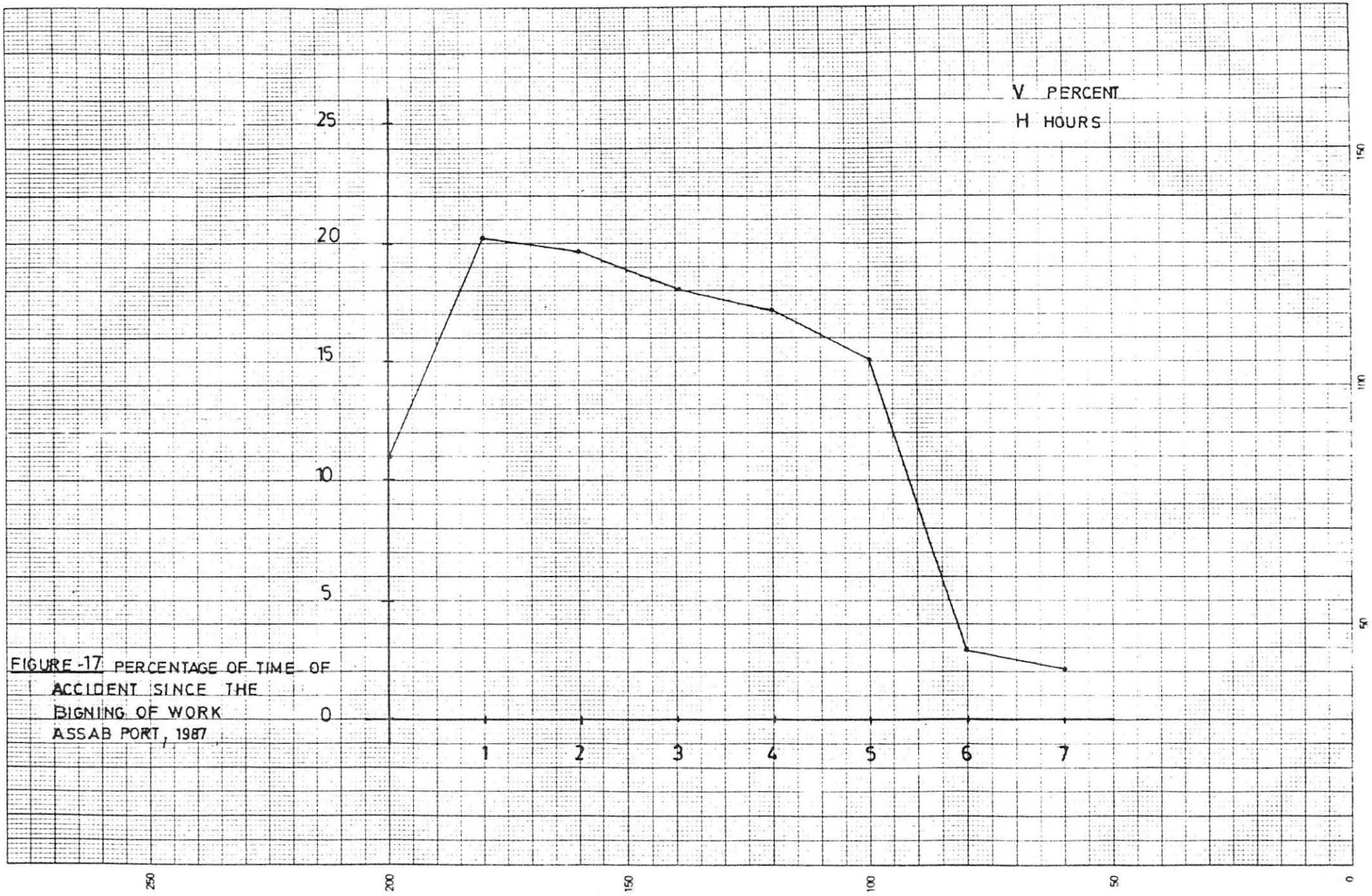


FIGURE-17 PERCENTAGE OF TIME OF ACCIDENT SINCE THE BIGNING OF WORK ASSAB PORT, 1987

Table 19. Percentage distribution of accidents by their nature. Assab, 1987

Nature of Injury	Number of accidents	Per cent
Amputation	1	0.4
Burn or scald	1	0.4
Burn (Chemical).	13	5.4
Concussion Brain - Cerebral	1	0.4
Contusion, crushing, bruise (intact- surface	28	11.6
Cut, laceration, Puncture- open wound	146	60.6
Dislocation	1	0.4
Fracture	17	7.1
Scratches and abrasions.	13	5.4
Sprain and strains	5	2.1
Multiple injuries	3	1.2
Other injury, NEC[1]	12	5
TOTAL	241	100

1= NEC = not elsewhere classified

Table 20 and Figure 19 shows the percentage distribution of part of body affected by accidents. The " Fingers" are the most affected with a percentage distribution of 19.5, then the lower leg and the foot follow with 11.2 per cent each.

F ACCIDENTS BY PART OF BODY AFFECTED.

Table 20. Part of body affected by accidents. Assab Port, 1987.

Part of body affected	Number of accidents	Per cent
Scalp	7	2.9
Ear (s)	2	0.8
Eye (s)	13	5.4
Jaw (include chin	1	0.4
Mouth (lips, teeth, tongue throat(.	1	0.4
Face, multiple parts	1	0.4
Face , NEC	9	3.7
Skull	2	0.8
Head, multiple parts	1	0.4
Head, NEC	3	1.2
Upper arm	2	0.8
Forearm	2	0.8
Wrist	3	1.2
Hand (not wrist or fingers)	12	5
Fingers	47	19.5
Upper extremities (multiple)	3	1.2
Upper wxtremities, NEC,	1	0.4
Back (muscles, spine and spinal cord).	7	2.9
Hips (pelvis, pelvic organs and buttocks)	1	0.4
Shoulder(s)	2	0.8
Trunk, multiple	1	0.4
Trunk, NEC	2	0.8
Thigh	4	1.7

Cont/

Part of body affected	Number of accidents	Per cent
Knee	8	3.3
Lower Leg	27	11.2
Leg, multiple	3	1.2
Leg, NEC	2	0.8
Ankle	9	3.7
Foot (not ankle or toes)	27	11.2
Toe (s)	20	8.3
Lower extremities, multiple	6	2.5
Lower extremities, NEC	2	0.8
Multiple Parts	10	4.2
TOTAL	241	100

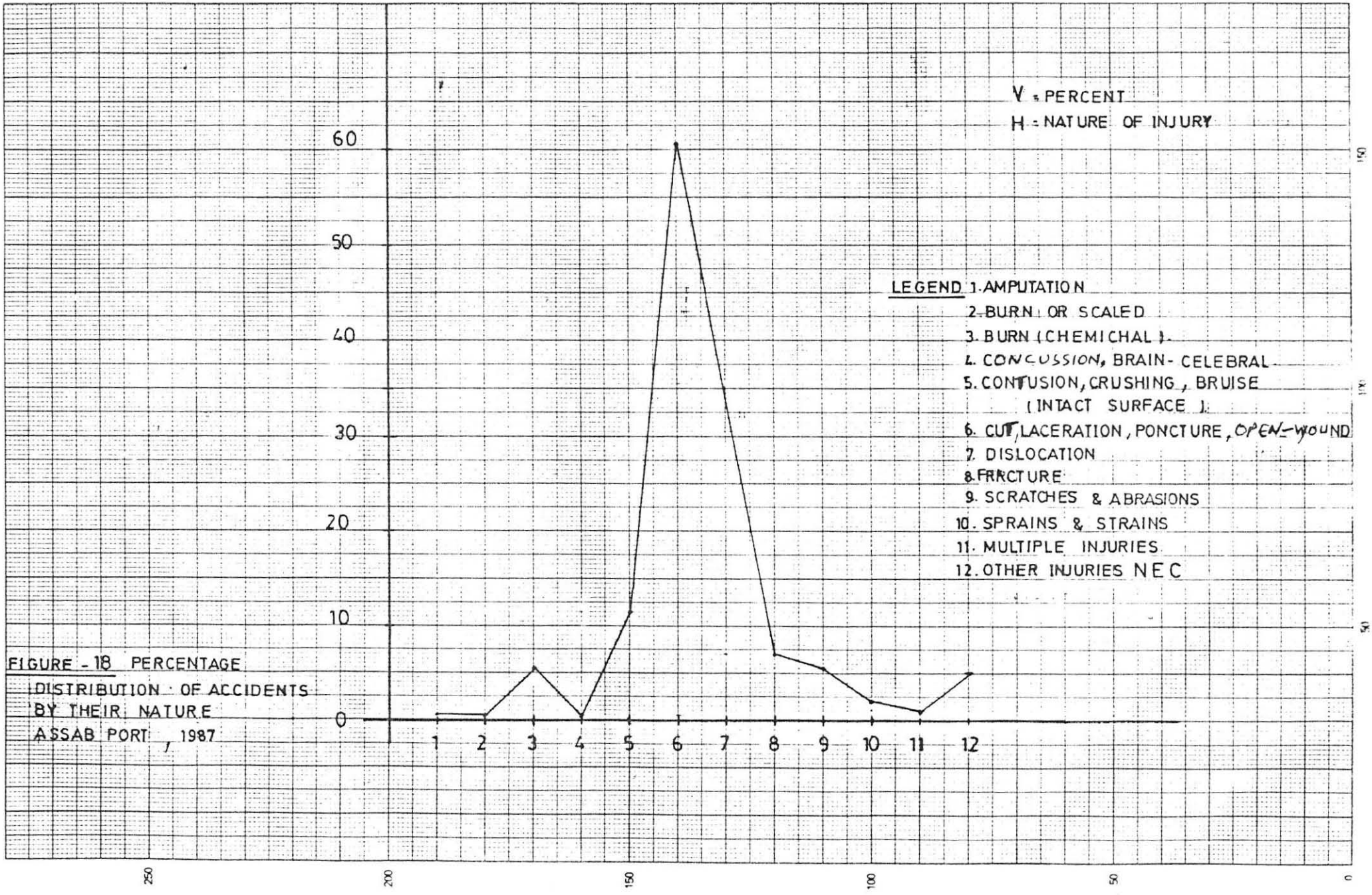
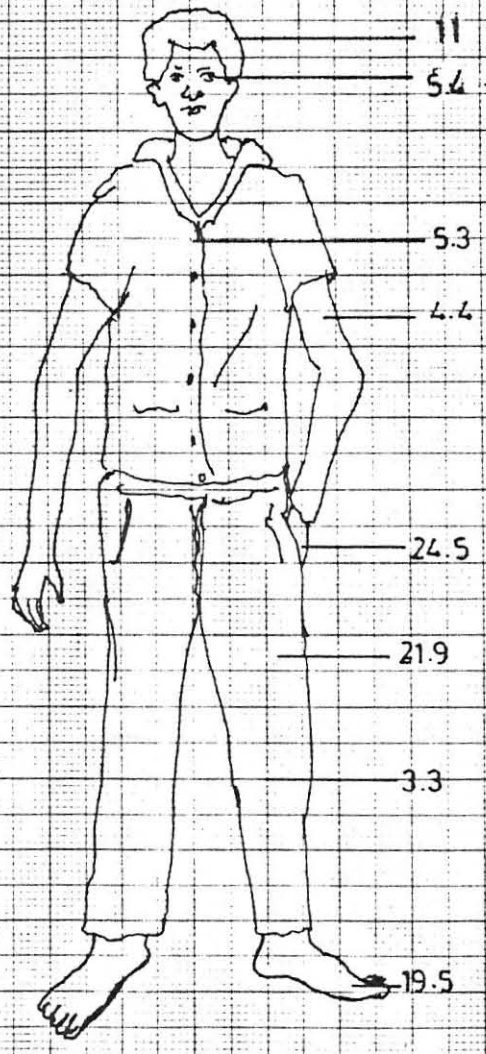


FIGURE - 18 PERCENTAGE DISTRIBUTION OF ACCIDENTS BY THEIR NATURE ASSAB PORT, 1987

FIGURE: 19 PERCENTAGE DISTRIBUTION OF ACCIDENTS BY PARTS OF BODY AFFECTED ASSAB PORT, 1987



G. ACCIDENTS BY THEIR SOURCE.

Table 21.. Percentage distribution of accidents by their source. Assab, 19

Source of injury	No. of accidents	Per cent
Animals, insects	1	0.4
Boxes, burrels, containers, packages (empty or full	17	7.1
Buildings and structures	3	1.2
Chemicals (Solid, liquid, gas)	13	5.4
Fod Products	3	1.2
Furniture, fixture, furnishings	2	0.8
Glass items, NEC[1]	4	1.7
Had tools, not powered	24	10.0
Hand tools, powered	1	0.4
Heating equipment	1	0.4
Ladders (fixed or portable	7	2.9
Machines	9	3.7
Metal items	62	25.7
Mineral item	43	17.9
Plants, frees, vegetation	2	0.8
Plastic items	1	0.4
Pumps and prime movers	2	0.8
Radiating substance and equipment	1	0.4
Scrap, debris, waste-materials.	2	0.8
Vehicles.	12	5.0
Wood items	22	9.1
Working surfaces	3	1.2
Miscellaneous	6	2.5
TOTAL	241	100

1= NEC = note elsewhere classified.

As one can see from table 21, 25.7% of the accidents had "metal items" as their source of injury.

H. ACCIDENTS BY THEIR TYPE.

Table 22. Accidents by their type. Assab Port, 1987

Type of accidents	Number of accidents	Per cent.
Struck against		
- stationary object	35	14.5
- Moving object	6	2.5
Struck by		
- Falling object	46	19.1
-struck by, NEC[1]	62	25.7
Fall from elevations		
-from ladders	5	2.1
-from piled madterial	2	0.8
-from yehicles	7	2.9
-NEC[1]	1	0.4
Fall on same level		
-fal to the walk ways or workers surface.	4	1.7
-Fall onto or against objects		2.1
-NEC[1]		0.8
Caught in, under, or between		
-A morning & stationery		4.2
-NEC	6	2.5
Rubbed or abraded		
-By objects being handled (not vibrating)	10	4.2
-By vibrating objects	1	0.4
By foreign matters in eyes.	3	1.2
-NEC[1]	4	1.7
Bodily reaction		
-From voluntary motions	3	1.2
Overexertion		
-In lifting objects	4	1.7
-In pulling or pushing objects	4	1.7
Contact with temperature extremes.		
-Hot objects or substances	1	0.4
Contact with radiations, caustic and noxious substances.		
-By Ingestion	1	0.4
-By absorption	10	4.2
-NEC	4	1.7
Accident Type, NEC	4	2.1
TOTAL	241	100

1 = NEC = Not elsewhere classified..

Observation of Table 22. reveals that " struck by" to be the type of accident in 44.8 percent. "Struck against" was the type in 17 percent of the accidents.

I. DISTRIBUTION OF ACCIDENTS BY CAUSES.

Table 23, gives the distribution of the 241 accidents in terms of the causes mainly Hazardous conditions and Unsafe acts.

Table 23. Accidents by Major Causes. Assab Port, 1987.

Major Causes	Number of accidents	Per cent
Hazardous Conditions	62	25.7
Unsafe Acts	40	16.6
Both Hazardous Conditions and Unsafe Acts.	139	57. 7
TOTAL	241	100

It can be seen from table 23, that the major causes in 57.7% of the accidents was both hazardous conditions and unsafe acts. In 25.7 % it was hazardous conditions alone and in 16.6% unsafe acts alone.

(i) HAZARDOUS CONDITIONS

Among the causes by hazardous conditions, Defects in agencies (35.2%), hazardous methods or procedures (22.5%) and placement hazards (22.4%) were the most frequent. The detailed list and percentage distribution of causes by hazardous conditions is presented in table 24.

Table 24. Distribution of Hazardous Conditions. Assab Port, 1987.

Type of hazardous conditions	No. of accidents	Per cent
Defects of agencies - Improperly compound, constructed, or assembled.	14	6.9
- Improperly designed.	1	0.5
- Rough.	2	
- Sharp.	14	6.9
- Slippery	13	6.5
- Worn, cracked, frayed, broken.	26	12.9
-Other defects, NEC[1]	1	0.5
Dress or apparel hazards. - Lack of necessary personal protective equipment	19	9.5
Environmental hazars, NEC - Inadequate clearance (for moving objects or Persons).	4	2.0
Insufficient work space	5	2.1
-Improper illumination	1	0.5
-Enviromental hazards, NEC!	1	0.5
Hazardous methods or procedures. -use of inherently hazardous (not defective) material or equipment	1	0.5
-Use of inherently hazardous methods or procedures.	7	3.5
-Use of inadequate (not defective) or improper tool or equipment.	6	3.0
-Inadquate help for heavy lifting.	20	10.0
-Hazardous methods or procedures, NEC.	11	5.5
Placement hazards (materials, equipment).		
---Improperly piled	7	3.5
- Improperly placed	32	15.9
- Inadequately secured against undesired motion	6	3.0
Inadequately guarded. -unguarded (mechanical, or physical).	2	1.0
- Inadequately guarded (mechanical, or physical).	8	4.0
TOTAL	201	100

1: NEC = Not Elsewhere classified.

(ii) UNSAFE ACTS.

The classifications, "Inattention to footing or surroundings " and "Improper use of hands or body parts" contributes to 18.4% 18% of the unsafe acts involved in the accidents respectively.

Table 25. Distribution of unsafe acts. Assab Port, 1987.

Type of Unsafe acts	Number of accidents	Per cent
Cleaning, oiling, adjusting -of moving equipment.	3	1.7
Failure to use available personal protective equipment (goggles, gloves, etc.)	15	8.4
Failure to wear safe personal attire	22	12.3
Failure to secured or warn. - Failure to lock, block, or secure vehicles, tools, materials and equipment against unexpected motion	3	1.7
-Failure to place warning signs, signals.	2	1.1
-Releasing or moving loads without giving adequate warning.	2	1.1
Horseplay	2	1.1
Imporoper use of equipment. -use of equipment for which is not intended	3	1.7
-Overloading (vehicles, scaffold etc).	4	2.2
-NEC!	4	2.2
Improper use of hands or body parts. -Gripping objects	15	8.4
- Taking wrong hold of objects.	8	4.5
- Using hands instead of hand tools.	8	4.5
-NEC!	1	0.6

(Table continue)

Inattention to footing or surroundings	33	18.4
Operating or working - at unsafe speed.		
-Feeding or supplying too rapidly.	2	1.1
Jumping from elevations (vehicles, etc)	2	1.1
-Running	2	1.1
-Throwing materials instead of carrying or passing	3	1.7
- NEC!	5	2.8
Taking unsafe position or posture: - Entering tanks, bins or other enclosed spaces with out proper supervisory clearance	2	1.1.
- Riding in unsafe position	2	1.1.
- Unnecessary exposure to swinging loads.	2	1.1.
- Unnecessary exposure to moving materials or equipment	8	4.5
-NEC!		
Driving errors.		
-Driving too fast or too slowly.	2	1.1.
Failure to signal when stopping,	2	1.1.
-turning, and backing	2	1.1.
-Following too closely	2	1.1.
-NEC[1]	2	1.1.
Unsafe placing, mixing, combining -Unsafe placing of vehicles -or materials moving equipment	2	1.1.
-Unsafe placement of materials, tools, scrap, etc.	4	2.2.
EEC!	2	1.1.
Using unsafe equipment (defective).	2	1.1
Total	179	100

1 = Not elsewhere classified.

1. MAN- DAYS LOST AS A RESULT OF ACCIDENTS.

The average man-days lost per accident works out to 6.5, the range being from 0 to 91 days.

There were two cases (0.8%) with expected permanent partial disability. The rate of seriousness as calculated by,

Number of days lost 1 100 is 0.5
Number of hours of work.

and the Index of seriousnes, as calculated by,

Total of permanent incapacity rates x 1,000,000 is , 0.3
Number of hours of work.

K. COST OF ACCIDENTS.

Break-up of expenditure involved in port accident over the 55 days is presented in table 26.

Table 26. Break-up of expenditure involved in port accidents (55 days)

Expenditure, Assab Port, 1987	Total	mean
1. Expenses due to loss of man-days	20459	84.9
2. Port clinic cost	3123	13.0
3. Out patient hospital cost	1256	5.2
4. In patient hospital cost	6768	28.1
TOAL OF THE ABOVE COSTS	31606	131.2

The expenditure involved in Assab Port accidents above is only for the 55 days of the study and does not include insurance and other indirect costs. One can extrapolate the results for the year.

L. MATCHED CASE - CONTROL ANALYSIS,

- *Point Estimation of the Odds Ratio, Approximate test of Significane and Confidence Limits.*

Table 27. Relation of safety training to accidents. Assab Port, 1987

"No safety training as exposure"		CONTROLS +	CONTROLS -	
CASES	+	235	3	
	-	1	2	
		236	5	241 pairs

Odds ratio = 3

Test of significane (X^2) = 0.25 (P> 0.05)

95% confidene interval = (0.2, undefined).

Eventhogh the above findings show an estimated odds ratio of 3, a test of whether the estimated odds ratio differs from unity is not significant at 5% significance level. Therefore, not having a safety training had not increased the risk of accidents in this particular study.

Table 28. Relation of sex to accidents.

"Male" as exposure		CONTROLS +	CONTROLS -	
CASES	+	236	1	
	-	3	1	
				241 pairs.

Estimated Odds ratio = 0.33

Test of significance (X^2) = 0.25 (P> 0.05)

95% confidence interval = (0, 5.7)

Eventhough the estimated odds ratio reveals 67% of protection from accidents in males, a test of whether the estimated odds ratio differs from unity is not significant at 5% significance level. Therefore the findings of this study suggest, Protection from encountering accidents in males is not higher than in females.

Table 29. Relation of the last one year sickness episodes to accidents.

"Sicknes episodes" as exposure		CONTROLS +	CONTROLS -	
CASES	+	201	9	
	-	26	5	
				241 pairs

Estimated Odds ratio = 0.35
Test of significance (X^2) = 7.31 ($P < 0.05$)
95% confidence interval = (0.1, 0.8)

The finding above suggest, 65% of protection from encountering an accident was observed in individuals who were having sickness episodes within the last one year compared to individuals without sickness episodes within the last one year ($P < 0.05$).

Table 30, Relation of previous sick days lost[3] to accidents, comparison of case- control pairs (dose - response).

Number of days lost	+- (ai)	-+ (bi)	Odds (ai/bi)	Odds ratio[1]	
0	201	9	22.333	1.0[2]	
1-5	10	3	3.333	0.15	
6-10	8	1	8.000	0.36	
11-15	3	1	3.000	0.13	
16-20	4	0	undefined	-	
21-25	1	0	undifined	-	

1= $(ai/b;) / (a_o/b_o$ X^2 test for trend =5.527 (P<0

2 = Reference group
3 = The number of man days lost as a result of illnesses in the past one year both in the cases and, controls were taken.

The findings in this study suggest, a trend in the odds of accident with decreasing man-days lost as a result of illnesses during the last one year. The estimated relative risk of an accident decreases with higher numbersof man-days lost as a result of illnesses during the last one year ($P<0.05$). Thus, those who had a sick-leave of 1-5 days have an 85% of protection from encountering accidents compared to those without sick -leave during the last one year. Those who had a sick-leave of 6-10 days have a 64% of protection from encountering accidents compared to those who ahd none, and those who ahd a sick -leave of 11-15 days have an 87% protection than those who ahd no sick leave.

Table 31. Relation of "Literacy status" to accidents

		CONTROLS		
"Illiterate" as exposure		+	-	
	+	3	18	
CASES	-	13	207	
	-			

241 pairs

Odds ratio = 1.38

Test of significance (X^2) = 0.5161 ($P>0.05$)

95% Confidence Interval = (0.6 , 3.2)

The result shows that the difference of the odds ratio from unity is not found to be statistically significant ($P> 0.05$)

Table 32. Relation of Educational status to accidents, comparision of Case-control pairs (dose -response.)

Educational Status	+ - (ai)	- + (bi)	Odds (ai/bi)	Odds ratio
0	3	18	0.167	1
1-6	13	109	0.119	0.713
7-12	0	96	0.000	0.000
>12	0	2	0.000	0.000

X^2 test for trend = 11.7061 ($P < 0.001$).

Eventhough the crude odds ratio for the exposure "illiterate" is not significantly different from unity ($P > 0.05$), a trend in the odds of "accident" with decreasing levels of educational status is suggested. The estimated relative risk of accident decreases with higher levels of educational status ($P < 0.001$). Thus, those with educational status, 1-6, 7-12 and above 12 grade have a 20%, 100% and 100% protection from encountering accidents respectively compared to those with educational status zero.

Table 33. Relation of Age to accident.

" Less tjam 30 years old" as an exposure		CONTROLS +	CONTROLS -	
CASES.	+	104	38	
	-	31	68	
				241 pairs

Odds ratio = 1.23

Test of significance (X^2) = 0.5217 ($P > 0.05$)
95% confidence Interval = (0.7, 2.1)

The estimated odds ratio is not different from unity ($P > 0.05$).

Table 34. Relation of age to accident, comparision of Case-Control Pairs (dose - response)

Age in Years	+ - (ai)	- + (bi)	Odds (ai/bi)	Odds ratio.
18-24	65	17	3.824	1.0
25-30	39	21	1.857	0.49
31-35	14	20	0.700	0.18
36-40	8	25	0.320	0.08
41-45	4	13	0.308	0.08
46-50	3	3	1.000	0.26
51-55	2	7	0.286	0.07

X^2 test for trend = 39.7386 ($P<0.001$).

Eventhough the crude odds ratio for the exposure "less than 30 years of age " is not significantly different from unity ($P> 0.05$), a trend in the odds of "accident" with decreasing categories of age is suggested. The estimated relative risk of accident decreas with increase in age ($P< o.001$).

Those with age categories, 25 -30, 31 - 35, 36 - 40, 41 - 45, 46 - 50 and 51-55, have a 51%, 82%, 92%, 92%, 74% and 93% protection in ecnountering accidents respectively compared to those in the age.

Group of 18 - 24 categories.

Table 35. Relation of total work experience in the port to accident.

"Experience less than one year" as exposure		CONTROLS +	CONTROLS -	
CASES	+	64	42	
	-	27	108	
				241 pairs.

Odd ratio = 1.6
Test of significance (X^2) = 2.8406 ($P> 0.05$)
95% Confidence Interval = (0.9, 2.7)

The estimated odds ratio is not different from unity (P> 0.05)

Table 36. Relation of work experiene in the port to accident, comparison of case control pairs (dose -response).

Experience in years	+ - (ai)	- + (bi)	Odds (ai/bi)	Odds ratio
0 - 1	19	6	3.1667	1
2 -4	68	77	0.8831	0.279
≥ 5	4	67	0.0597	0.019

X^2 for trend = 51.5896 (P< 0.001)

Eventhough the crude odds ratio for the exposure "experience in the port less than one year " is not significanlty different from unity (P> 0.05), a trend in the odds of accident with decreasing work experience in the port is suggested. The estimated relative risk of accident decrease with increase in work experience . Thus , those with work experience in port, 2 -4 and above 5 years have a 72% and 98% protection of encountering an accident respectively, compared to those with experience of work 0-1 year.

Table 37. Relation of work experience within the same work category in the port to accidents.

"Work experience less than one year within same work category" as exposure		CONTROLS +	CONTROLS -
Cases	+	94	32
	-	25	90

Odds ratio = 1.28

Test of significance (X^2) = 0.6316 (P> 0.05)
95% confidence Interval = (0.7, 2.3)

Table 38. Relation of work experiene within the same work category in the port to accident, comparison of Case -Control pairs (dose-response).

Work experience within same category (YB)	+ - (ai)	- + (bi)	Odds (ai/bi)	Odds ration
0-1	24	6	4	1
2-4	88	56	1.5714	0.393
$\geq$ 5	7	60	0.1167	0.029

X^2 test for trend = 56.0856 ($P < 0.001$)

Eventhough the crude odds ratio for the exposure " experience leass than one year within the same work category in the port" is not significantly different from unity ($P > 0.05$) , a trend in the odds of accident with decreasing work experience with the same work category in the port is suggested. The estimated relative risk of accident decrease with increase in work experience within the same work category in the port. Thus, those with work experience within same category of 2-4 and above 5 years, have a 61% and 97% protection from accidents respectively compared to those with 0-1 year work experience within the same work category in the port.

CHAPTER V. DISCUSSION.

The overall accident rate of 8.2 per 100,000 :- man-hours worked, 40.6 per 1,000 workers at risk, or 2.03 per 100 employee -months observed in this study is expectedly lower than the accident rates of 1984 - 85, and 1985 - 86 in the port of Assab, which were 9.5/100,000 worked man-hours, 378.1/1,000 workers at risk, or 3.2/100 employee-months respectively. This is because in 1984 - 85 and 1985 - 86, the number of workers and worked man -hours for the department of engineering were not included in the denominators which could have inflated the actual rates. The similarity pattern in the port activity among the years, 1984 -85, 1985 - 86, and the year of the study was ensured by the total cargo transboarded which were 1,335,051, 1,566, 505, and 1,361,655 metric -tons respectively for each year.

Higher rate of accidents compared to the Assab port study were reported by P.C. Jean, in France with an accident rate of 43/100,000 worked man-hours for all industries, 54/100,000 man-hours for workers in transport and goods-handling and 29.4/ 100,000 man -hours in 1968, 31.9/100,000 man -hours in 1969 for all the French ports (18).

The index, rate of accidents per 100 employee-months was chosen as the most convenient by Sutherland, Harris, and Smithers (1950) who reported 14.5 accidents per 100 employee- months in an assembly factory and 49.4 in a light engineering factory (41) which were also higher than the findings in this study.

The differences in the industrial accident frequency rates observed between the port of Assab study on the one hand, and the U.K., and French studies on the other hand are enormous and difficult to explain. Sutherland, like the Assab port study recorded every accident whatever trivial, but it is possible that medical facility in the British factories was obtainable at a shorter distance, more easily, and possibly in a more welcoming environment. Vernon (1936) reported nearly 2 minor accidents a year per man employed at the Stanton Iron works between 1927 and 1932, and at three other large works, the character of which was not stated, in one year 9,000 workers sufferred 563 reportable accidents and 41,160 accidents requiring first aid. These figures approach an average of 5 accidents a man each year, or 41.7 accidents per 100 employee -months (44). To the contrary, repeaters of accidents were not included in the study of accidents in the port of Assab.

On the other hand, lower rate of accidents were reported by D.B. Ghosh, with an accident rate of 0.4/100 employee-months among railway employees at Allahabad, India (8), which are similar to those of mine workers, 0.4/100 employee-months (9), port and dock workers, 0.4/100 employee-months(48), as well as among the armed forces personnel at Allahabad (49). The Ghosh (1981), observation was based on injuries that have caused at least 24 hours restriction of work to the individual and the industry chosen for his study has no major workshops or large technical units. The findings, therefore, do not necessarily reflect the true nature of the accident pattern among industrial employees.

An Indian all factories and Textiles, reported accident rates per 100 employee-months for 1968, 1969, 1970 and 1971 were (0.5, 0.7), (0.5, 0.9), (0.6, 1.1), and (0.6, 1.3) prespectively (14). The figures represent accidents which caused disablement at least for 48 hours, which could have caused a reduction in the rate of accidents.

Reportable " three day" industrial injury in the U.K. (Factory Inspectorate, 1966) shows, 1.1 injuries per 100 employee - months among the dockers and 0.6 injuries per 100 employee - months among workers in shipbuilding and repairing (11).

A nine year record of injury frequency rate for longshoring in the U.S.A per 100 employee-months puts the range between 1.01 and 0.6 for the years 1960 to 1969 (12). In the Singapore dockyard an equivalent rate per 100 employee-months for 1955 and 1956 were 0.6 and 0.3 (13).

When the very minor accidents at Singapore are included, the rate of accidents for all industrial workers approach that of the rate observed in the Assab port accident study. The rates in 1955,and 1956 for all industrial workers in Singapore were 2.38, and 1.76, respectively per 100 employeemonths. Nor is this due to a weighting of the rates by a majority of the workers being engaged in less dangerous jobs. The work of a port embraces most forms of industrial activity and the largest departments are those of operation and of engineering.

The level of activity in the ports and the time needed to load and unload the cargo in question could be a possible explanation for the differences observed in the rate of accidents. The other possible explanation for the difference could be due to the fact that some countries have had regulations and policies on Safety and Health which were implemented earlier, but still does not exist in Ethiopia. Finally, overall crude rate of accidents which were not standardized for categories of department, age, sex, and other relevant factors might have an effect of bias in the comparision of two or more overall crude rates..

The highest rate of accidents was produced by the department of port club,which, with 42 workers,gave an accident rate of 32.6/100,000 man-hours , 166.7/1,000 workers at risk, or 8.3/100 employee -months. The high rate of accidents in this small department was due to a single mishap in the department injuring 4 persons at a time, and the 7 total injuries sustained in this department were very minor in nature. Otherwise high rate was observed in the department of "Haleb boatyard construction project", with an accident rate of 15.5/100,000 worked man -hours, 77.8/1,000 workers at risk, or 3.9/100 employee-months. The observation, therefore not necessarily reflect the true nature of the pattern of accidents among the different departments.

The highest departmental rate of accident in the Singapore dockyard in 1956, 5.28 per 100 employee - months was lower than the findings in this study and was produced by the department of "victualling stores" (13) . The difference in the departmental rate of accidents could also be due to the differences in the overall accident rates between the two findings. D.B. Ghosh, reported the highest departmental accident rate by the medical department. With 181 workers, out of the total 4660 workers, gave an accident rate of 99.44/1,000 exposed workers, or 0.8/100 employee-months (8). The differences observed between the Indian railway study and the Assab port study is due to the inclusion of non-industrial workers who were not at risk of encountering industrial accidents in the Indian study which probably caused a bias in the finding.

Maximum accident rate was observed in the age group ranging between 18-24 years. Those with age categories, 25-30, 31-35, 36 -40, 41 - 45, 46 - 50, and 51-55, have a 51%, 82%, 92%, 92%, 74%, and 93%, respectively of protection from encountering accidents compared to those in the age group of 18 - 24 years.

They differ from the finding of Brundage (1927) who showed a comparatively steady frequency rate up to the age of 50 and then a fall (39), the experience of C.P. Collins (1958) in a Singapore dockyard showed, an increase in the rate of accidents to a peak in the second age group and falling steadily thereafter among the chinese, and the occurrence of peak accident rate in the age group 36 to 45 among the Malays (13). The rates for the Singapore dockyard

study were based on an average of two years with very different accident records which are of course misleading. But Hewes (1921) who, dealing with 2,891 male employees of a Connecticut silk mill, showed that the frequency of accidents was greater under 20 years of age but dwindled steadily thereafter (37). This was also the experience of Schmitt (1926), (39).

Similar observations have been reported by Ghosk .D.B. (23), Johri, S.C. (49) and Gordon, J.E. (51).

McFarland (1957) quoted the records of an industrial physician of Ohio, that "50 % of the industrial accidents occurred in people under the age of 25, and that the rate for the 20-24 year group was more than twice that of the 40-44 age group". The Physician has rightly termed accidents as " an affliction of the youth." 40).

Sutherland et al. (1950) show, in both groups of factories the highest rates in the youngest age groups decreasing exponentially to a minimum over 55 years of age of between one -third and one- quarter the rates of those under 20(41).

Kossoris (1948), however, agrees in showing that among 18,000 factory workers the frequency of non-disabling injuries showed a steady decline from the 25 to 27 age group onwards (42).

Recent figures from the U.S.A. have revealed that younger workers have more accidents than older workers (30).

The inherent agility of the comparatively young population, more physical work and immaturity perhaps contribute to this high incidence. The results are useful for further intervention programmes.

The findings in the Assab port study suggests, the absence of differences in the rate of accidents between males and females ($P > 0.05$) which is different from recent findings in the U.S.A. that young male workers have about twice as many accidents as young female workers (30). The difference between the two findings could be due to the reduced validity of the statistical test of significance, because the sample size of the females was too small (1.2%) compared to the sample size of the males (98.8).

The estimated relative risk of accident decreases with higher levels of educational status, ($P < 0.001$). Those with educational status, 1-6, 7 - 12, and above grade 12, have a 29%, 100% , and 100% respectively of protection from encountering accidents compared to those with no formal education. A reasonable conclusion that can be used for planning future intervention programme can be made from this finding.

There is no significant difference in the rate of accidents among the skilled, the unskilled, and the apprentice ($P > 0.05$). Highest accident rate was observed in the worker's job title "Electrician, welder, plumber, and carpenter". compared to the other job titles, listed in table 14 of the result part, ($P < 0.01$).

The estimated relative risk of accident decreases with increase in the total work experience in Assab Port. Those with a total work experience in the port, 2-4, and above 5 years have a 72% , and 98%, respectively of protection from encountering an accident compared to those with a total, 0 -1 year experience of work in the port. This agrees with a recent finding in the U.S.A. (30). This was also the experience of D.B. Ghosh, (1981), (8). By further extending the investigation, a 61%, and 97% of protection from encountering accidents was found in workers with 2-4, and , above 5 years respectively of experience within the same work category in the Assab port. The findings above indicate a human factor as a determinant in the incidence of accidents and points for futher accident prevention.

Not having a training on safety had not increased the risk of accidents in the Assab port study. This difference from the already established fact could be due to the reduced validity of the statistical test of significance, because the sample size of individuals who took training on safety was too small (1.7%), compared to the sample size of individuals who did not take training on safety (98.3%).

The estimated relative risk of an accident decreases with higher numbers of man-days lost as a result of illnesses during the last one year, ($P < 0.05$). Those who had a sick leave of 1-5, 6-10, and 11-15 days have an 85%, 64%, and 87% respectively of protection from encountering accidents, compared to those with no sick leave or with an illness that did not require a day off from work as judged by the physician . From the point of view of testing the hypothesis, the findings in the Assab

port study suggest, a decrease in the risk of encountering an accident as one becomes frequently sick. This could possibly be explained by a decrease in the risk of exposure when the worker is away from work.

This finding differs from the findings of other countries (52) and (53). The possible explanation for the difference could be the use of an indirect method of diagnosis (sick-leave days) for diseases in this study, which was not used by the others. The findings in this study with respect to this particular determinant is not free from bias, because sick -leave days soley depend on the judgement of the physician. Individuals with frequent illnesses, or with chronic diseases are one of the risk groups in the epidemiology of accidents.

During the six week days, all employees were present, but on Sundays, as an average, only about 5% were working. On Saturdays, one shift was worked in place of the usual three. The accident frequency was highest on Mondays and fell to its lowest level at mid-week, with an increase once more on Saturdays. The possible explanations in this distribution are absenteeism of workers which is always higher on Mondays than on other days of the week resulting in workers having to stand in for absent colleagues and having to undertake unfamiliar jobs that day. This agrees with a Singapore naval dockyard of C.P. Collins (1958) for Mondays, Thursdays, Fridays and Sundays, (25.2%, 10.4%, 19.4%, and 1.4%), but not for the Tuesdays, Wednesdays, and Saturdays (24.3%, 11.7%, and 7.6%), (13).

In Factory B of Sutherland et al. (1950) for the first three days of the week (476, 466, and 424 accidents) and for the next two days (481 and 393) accidents were observed (41). Sutherland's Factory A was different on all counts.

Vernon (1918) showed that, with a 12-hour working day, accidents were most frequent on Mondays, sinking to a minimum on Fridays, with an increase once more on Saturdays, and related this to some extent to the consumption of alcohol (44). This factor would apply very much in Assab.

The 5,930 port workers classified as "industrial" work on 3 shifts. The distribution of time among the shifts are equal, except that the number of workers in the second and third shifts are less than the number of workers in the first shift. The difference in the rate of accidents among the 3 shifts is significant ($P < 0.001$). The highest accident rate was observed in the second shift (10.6/100,000 man-hours, 50.4/1,000 workers, or 2.52/100 employee -months) with the second higher frequency rate observed in the first shift, (9.7/100,000 man-hours , 50.2/1,000 workers, or 2.51/100 employee -months). Thus the frequency of accidents is highest in the afternoon, in comparison to that of the morning and the night. Similarly, the rate of accidents is higher in the day shift than the night shift. The most probable explanation for the observed difference is that the high environmental temperature reaches its peak in the second shift.

This differs from the findings of C.P. Collins (1958), who , in a Singapore dockyard study reported 6.7 accidents per hour in the mornings and 4.5 accidents per hour in the affternoons. The difference could be explained by the bias introduced by C.P. while calculating the rates. Collins, ignored to use either the worked man-hours or employee- months in the denominators to calculate the rates .

Amongst the agent factors, struck by (44.8%) and struck against (17%) constituted the bulk of the causative agents. The resultant injuries sustained were mainly laceration, and puncture - open wound (60.6%). However, more serious type of injuries were Fractures (7.1), head injuries (0.4%), and amputations (0.4%). A sizeable number of burn injuries (5.8%) also figured among the severe types. The lower leg and the foot are the most affected with, 11.2% each next to the fingers (19.4%) . 25.7% of all the injuries had metal items as their source of injury.

These are evidently the groups which require closed supervision and an increase of safety instruction among the workers. The National Safety Council of U.S. (1952) reported that, in the United States, 22% of all industrial accidents were caused during handling stores, 17% by falls, and 16% by machinery (54). Taylor (1954) gives 27%, 14%, and 16%, respectively in these categories (55). In the Singapore dockyard the corresponding percentages were 17.1, 7.8, and 14.4 in 1955, and 8.7, 12.6, and 7.2 in 1956 (13). The differences observed in the results between the Assab port study and other countries could be due to

the different classification methods and presentations used. Reports of the National Safety Council and Taylor were in 1952, and 1956, respectively. Since then there was a modification and improvement in the classification systems.

The major causes in 57.7% of the accidents in the Assab port were both hazardous conditions and unsafe acts. In 25.7%, it was hazardous conditions alone, and in 16.6% unsafe acts alone. The findings above indicate hazardous conditions to be the dominant in the cause of accidents. There is obviously considerable scope for improvement of the hazardous conditions as one of the methods of future accident prevention strategies. This was also the experience of M. Murashetty in Indian Textile factories (5).

Among the causes by hazardous conditions, defects in agencies (35.2%), hazardous methods or procedures (22.5%) and placement hazards (22.4%) were the most frequent . M. Murashetty reported the same pattern in an Indian textile factories (5). The classifications " Inattention to footing or surroundings" and " Improper use of hands or body parts" contributed to 18.4% and 18% respectively of the unsafe acts involved in the accidents.

A total of 1,571 man-days were lost due to the 241 accidents. The average man-days lost per accident works out to 6.5, the range being from 0 to 91 days. This differs from the findings of M. Murashetty (1975) who reported 12.4 average man-days lost per accident (16) . S.Purushothama (1975) reported 10 average man -days lost per accident (17). D.P. Ghosh (1981)

also reported 21.9 average man-days lost (8).

The differences between the Assab port and the other studies is due to the difference in the criteria set to select cases whereas, the Assab port study included all cases whatever trivial.

The rate of seriousness and index of seriousness for Assab port study were 0.5 and 0.3 respectively which significantly differs from the findings in all French ports. In all the French ports for the year 1968, the rate of seriousness and the index of seriousness reported were 12 and 424 respectively (18). The difference in the findings of the two countries could possibly be the study period which was only 55 days in the Assab port. If the study was extended over the whole year, more serious accidents could have been encountered.

The sum of the medical and man-days lost cost of the 241 accidents in Assab port was 31,606 Birr, the average being 131.2. The average cost of an ordinary accident in all French ports were US$. 1,720 in 1966, 1,980 in 1967, and 1,999 in 1968 (18). The difference in the findings of all French ports and Assab port study is that in Assab port study, the expenditure involved was only for the 55 days of the study and did not include insurance, compensation, and other indirect costs.

CHAPTER VI. CONCLUSIONS AND RECOMMENDATIONS.

A case - Control study was conducted from October 16, 1987 among workers in Assab port to describe the occurrence and deferminants of accidents, which is one of the ten top causes of morbidity in Assab awraja. The total number of workers at risk of encountering an accident were 5930 and the man-hours worked for the study period were 2,932,705.

The total number of accidents that occurred among workers exposed to the risk of accidents were 241 (4.1%), giving a late of 8.2 accidents per 100,000 worked man-hours, 40.6 accidents per 1,000 exposed workers, or 2.03 accidents per 100 employee -months.

The highest departmental accident rate was produced by the department of haleb boatyard construction project with an accident rate of 15.5 per 100,000 man-hours, 77.8 per 1,000 workers at risk, or 3.9 per 100 employee- months.

I. ENVIRONMENTAL AND HUMAN FACTORS.

The observed rate of accidents could be attributed to environmental and human factors. Both environmental and human factors were involved in 57% of the accidents in Assab port. In 25.7%, it was the environmental factor alone and in 16.6% the human factors alone.

1. Among the causes by environmental factors, the most frequent once were:

(i) Defects in agencies (35.2%)
(ii) Hazardous methods or procedures (22.5%), and
(iii) Placement hazards (22.4%)

(i) Defects in agencies include:
(a) Improperly compounded, constructed, or assembled (6.9%).
(b) Improperly designed (0.5%)
(e) Rough (1%)
(d) Sharp (6.9%)
(e) Slippery (6.5%)
(f) Worn, cracked,frayed, broken (12.9%), and
(g) Other defects not elsewhere classified (0.5%).

(ii) Hazardous methods or procedures include:
(a) Use of inherently hazardous (not defective) material or equipment (0.5%)
(b) Use of inherently hazardous methods or procedures (3.5%)
(c) Use of inadequate (not defective) or improper toal or equipment (3%)
(d) Inadequate help for heavy lifthing (10%), and
(e) Hazardous methods or procedures, not elsewhere classified (5.5%)

(III) Placement hazards include:
(a) Improperly piled (3.5%)
(b) Improperly placed (15.9%), and
(c) Inadequately secured against undesired motion (3%).

2. *Among the causes by the human factors, the most frequent causes were:*

   (i) Inattention to footing or surroundings (18.4%).
   (ii) Improper use of hands or body parts (18%), and
   (iii) Failure to wear safe personal attire (12.3%).

(ii) Improper use of hands or body parts include:

   (a) Gripping objects insecurely (8.4 %)
   (b) Taking wrong hold of objects (4.5%).
   (c) Using hands instead of hand - tools (4.5%) and
   (d) Not elsewhere classified (0.6%)

The determinants identified for the human factors from the study are:

- *Age of the worker*
- *Educational status of the worker.*
- *Job title of the worker.*
- *Experience of the worker in the port and,*
- *Work shift of the worker.*

Age of the worker.

Assab port workers 18-24 years of age are one of the risk groups in the epidemiology of accidents.

Educational status of the worker.

Assab port workers with no level of formal education are risk group in the epidemiology of accidents.

Job title of the worker

The third risk group in accident epidemiology in the port are workers with the job title "Electrician, Welder, Plumber and carpenter".

Experience of the worker in the port

Another risk group identified among workers in the port is workers with 0-1 year work experience in the port.

Work shift of the worker.

Workers in the second shift are also another risk group in port accidents.

Amongst the agent factors, struck by (44.8%), and struck against (17%) constituted the bulk of the causative agents.

II SAFETY ORGANISATION

(i) A firm and well defined safety policy was not found declared in Assab port . Also, there was considerable scope for improvement in the support and led provided by the top managements on matters of safety. Adequate support and leadership from the top management, a well defined safety policy and clear objectives are the basic essentials for success in accident prevention. In the absence of these, the middle management and, in turn, the workers were not sufficiently motivated towards safety.

(ii) No fulltime Safety Officer was employed in the port. The staff functions related to safety were looked after by a part time worker from the port personnel department. It is essential to have a fulltime Safety Officer in the port to attend to the various safety functions effectively.

(iii) A safety committee is non-existant in the port. A safety committee should be formed and properly organized as soon as possible, which could be an effective body for coordinating all safety activities.

(iv) Investigation and record of accidents, in general, was far from satisfactory. The investigations and the records served very little to bring out the various causative factors. There was considerable scope for improvement in this regard as well as in following up the measures which have to be adopted as arrived at after investigations.

(V) In general, the plant inspection systems also left much to be desired. Systematic inspections and follow-up till the environmental factors and human factors are rectified, is necessary. From the findings of this study, systematic inspection should focus on the following environmental factor.

- Improperly compounded, constructed or assembled agencies.
- Improperly designed agencies.
- Rough, sharp and slippery agencies
- worn, cracked and broken agencies
- Use of inherently hazardous (not defective) material or equipment .
- Use of inherently hazardous methods or procedures.
- Use of inadequate (not defective) or improper tool or equipment.
- Inadequate help for heavy lifting.

- *Improperly piled materials or equipment*
- *Improperly placed materials or equpment , and*
- *Inadequately secured against undesired motion.*

Frequent plant inspections by various levels of personnel and effective follow up are essential.

(vi) To effectively reduce the accidents resulting from the human factors, efforts in the area of safety training and education, safety supervision, and safety communication were necessary. The efforts should focus on the risk groups identified from the findings of this study, who are:

- *port workers between the ages of 18-24 years.*
- *port workers with no formal education.*
- *port workers who are electricians, welders, plumbers and carpenters.*
- *port workers with 1 year and less work experience in the port, and*
- *Port workers, employed to work in the second shift.*

The training, education and supervision should focus on the human factors identified as a major cause of accidents in the port, which are:-

- *Inattention to footing or surrounding*
- *Gripping objects insecurely*
- *Taking wrong hold of objects*
- *Using hands, instead of hand tools.*
- *Failure to wear safe personal attire*
- *The dynamics of accidents caused by struck against*

stationary and moving objects.

- *The dynamics of accidents caused by struck by falling objects.*

A N N E X E S

THE OCCURRENCE AND DETERMINANTS OF ACCIDENTS IN ASSAB PORT WORKERS-DATA ENTRY FORM.

1. Study No.

   Address:- Kefetegna ----------
   Kebele ----------
   House No. ----------

   1 - 3

2. Age. ---------- Years.

   4 - 5

3. Sex.

   1. ☐ Male
   2. ☐ Female

   6

4. Educational status

   ☐ Illiterate
   ☐ Literate

   Lox---------- Highest grade

   7 - 9

5. Place or location of Accident

   1. ☐ Dock
   2. ☐ Construction area
   3. ☐ Power station
   4. ☐ Garage
   5. ☐ Wood Work
   6. ☐ Others specify _____
      _____
      _____

   10

6. Date of Accident

   Month / date

   11 - 13

7. Day of week in which accident occurred.

1. ☐ Wonsday
2. ☐ Tuesday
3. ☐ Wednesday
4. ☐ Thursday
5. ☐ Friday
6. ☐ Saturday
7. ☐ Sunday

☐ 14

8. Accident's time of the day

--------- / --------
Hours Min

☐☐ 15 - 16

9. Time of beginning of work

-------- / ---------
Hours Min

Number of hours since beginning of work ---------- / ----------
Hours Min

☐☐ 17 - 18

10. Health facility attended

1. ☐ Port clinic
2. ☐ Hospital

☐ 19

11. Years of service --------- / ----------
Years Months

☐☐☐ 20 - 22

12. Time on present job ----------/---------

☐☐☐ 23 - 25

13. Worker category:-

1. ☐ Skilled
2. ☐ Unskilled
3. ☐ Apprentice

☐ 26

14. Payment method.

1. ☐ Plece work
2. ☐ Time rate
3. ☐ Salary

☐ 27

15. Department.

1. ☐ Operation
2. ☐ Engineering
3. ☐ Harbour Master
4. ☐ Haleb Project
5. ☐ Other specify _____

☐ 28

16. Work Site.

1. ☐ Dock
2. ☐ Construction area
3. ☐ Power station
4. ☐ Garage
5. ☐ Wood work
6. ☐ Others specify _____

☐ 29

17. Worker's occupation / TITLE /

1. ☐ Daily labourer
2. ☐ Clerk of different types
3. ☐ Mechanic insluding machinist
4. ☐ Operation of different machines

5. Seaman

6. Forman and shift Co-ordinators

7. Electrician, welders, plumbers and carpenter's.

8. Othrs specify _____

□ 30

18. Did worker took safety training before?

1. No □ 31

2.

19, Number of working days lost in the past 1 year due to illnesses. ---------- □□□ 32 - 34

20. Number of illness episodes in the past 1 year that made the worker loose working day.---------- □□ 35 - 36

21. Nature of injury

---------- □□□ 37 - 39

22. Part of body affected

---------- □□□ 40 - 42

23. Source of injury

---------- □□□□ 43 - 46

24. Accident type

---------- □□□ 47 - 49

25. Hazardous condition

---------- □□□ 50 - 52

26. Unsafe act

---------- □□□ 53 - 55

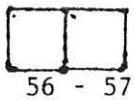
27. Severity of injury.

----- Days of work lost
(-90 days, code as 90<9

91. Expected permanent partial disability.

92. Expected permanent total.

93. Fatality


56 - 57

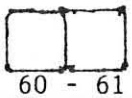
28. At that time did you stop drinking alcohol before coming to work?

Time----------
Hours/Min. International local time.

Number of hours before beginning work or shift----------


58 - 59

Number of hours before accident
If - 24 hours, code as 24


60 - 61

29. What did you take in the 4 hours

- Beer, how many bottles----------
- Whisky,arakie,gin and other hard liquor, how many"single Shots"----
- Wine, how many glasses----------

Total No.,of drinks:----------


62 - 63

30. Breathalizer

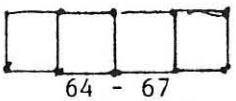
Time of test:----------

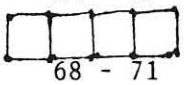
Time in minutes between accident and the test:---------- minutes

60 = ----------
Hrs Bec

Test result ----------

Corrected test result----------


64 - 67


68 - 71

31. Work days lost due to the accident.

a) Salary ----------

b) Certified days lost ----------

c) Divide salary by cert. days lost------

d) Expected insurance cost----------

e) Expected disability cost----------
TotL COST = c + d + e


72 - 75

---

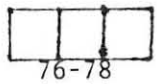
32. Port clinic cost

a) Total anual salary budget of clinic ----------

b) Number of total anual dvisits
62,000

c) Cost of treatement and diagnoses ----------

Divide a by b and c to get the total accident cost of the case ----------



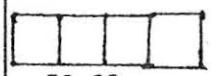
33. Hospital cost (out-patient).

a) Total anual salary budget of out patient 14820

b) Total number of annual visits
30986

c) Cost of treatement and diagnosis of the specific accident case -------

Divide a by b and add c to get the total accident cost of the case ----------



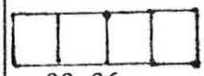
34. Hospital in-patient cost.

a) Total anual hospital budget 1681175

b) Total number of anual bed days 76650

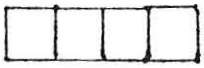
c) Patient days in hospital ----------

Divide a by b and multiply it by c toget the hospital cost ----------



35. Total cost.

Add port clinic cost,hospital and hospital in patient cost to get the total ----------



DRAW DETAILED CAUSAL FREE AND DESCRIPTION

OF THE ACCIDENT WITH A PHOTOGRAPH.

SELECTED CODES FROM ANSI

Z16.2-1962(R1969)

This material is reproduced with permission from American National Standard Method of Recording Basic Facts Relating to the Nature and Occurrence of Work Injuries (Appendix), ANSI Z16.2-1962(R1969), copyright 1963 by the American National Standards Institute, copies of which may be purchased from American National Standards Institute,1430 Broadway, New York, New York 10018. This is intended to serve as a reference list for the forms suggested in Chapter 7. It is not intended to replace the methodology described in ANS [illegible] t no narrative descriptions explaining code usage have been reproduced. The reader is encouraged to obtain and use the entire standard if it applies to his specific recordkeeping needs.

A1.1 Nature of Injury Classification

Code

100 Amputation or enucleation

110 Asphyxia, strangulation, drowing

120 Burn or scald (heat)- The effect of contact with hot substances. Includes electric

APPENDIX

1

burns, but not electric shock. Does not include chemical burns, effects of radiation, sunburn, systemic disability such as heat stroke, friction burns, etc

130 Burn (chemical)-Tissue damage resulting from the corrosive action of chemicals, chemical compounds, fumes, etc (acids, alkalies)

140 Concussion-Brain, cerebral

150 Contagious or infectious disease-Anthrax, brucellosis, tuberculosis, etc

160 Contusion, crushing, bruise-Intact skin surface

170 Cut, laceration, puncture-Open wound

180 Dermatitis-Rash, skin or tissue inflammation, including boils, etc. Generally resulting from direct contact with irritants or sensitizing chemicals such as drugs,oils,biologic agents,plants,woods,or metals, which may be in the form of solids,pastes,liquids,or vapors and which may be contacted in the pure state or in compounds or in combination with other materials. Does not include skin or tissue damage resulting from corrosive action of chemicals, burns from contact with hot substances,effects of exposure to radiation,effects of exposure to low temperatures,or inflammation or irritation resulting from friction or impact

190 Dislocation

200 Electric shock, electrocution

210 Fracture

352 / Selected Codes from ANSI Z16.2-1962 (R1969)

App.1

220 Freezing,frostbite,and other effects of exposure to low temperature

230 Hearing loss,or impairment(a separate injury,not the sequelae of another injury)

240 Heat stroke,sunstroke,heat cramps,heat exhaustion,and other effects of environmental heat. Does not include sunburn or other effects of radiation

250 Hernia,rupture-Includes both inguinal and noninguinal hernias

260 Inflammation or irritation of joints,tendons,or muscles-Includes bursitis,synovitis,tenosynovitis,etc. Does not include strains, sprains,or dislocation of muscles or tendons,or their aftereffects

270 Poisoning,systemic-A systemic morbid condition resulting from the inhalatio inhalation,ingestion,or skin absorption of a toxic substance affecting the functioning of the metabolic system,the circulatory system,the digestive system,the respiratory system,the musculo-skeletal system,etc. Includes chemical or drug poisoning,metal poisoning,organic diseases,and venomous reptile and insect bites.Does not include effects of radiation,pneumoconiosis,corrosive effects of chemicals;skinsurface irritation; septicemia or infected wounds

280 Pneumoconiosis-Includes anthrocosis,asbestosis,sillicosis,etc

290 Radiation effects-Sunburn and all forms of damage to tissue,bones,or body fluids produced by exposure to radiations

300 Scratches,abrasions (superficial wounds)

310 Sprains,strains

400 Multiple injuries

990 Occupational disease,NEC*

995 Other injury,NEC

999 Unclassified,not determined

A1.2 Part of Body Affected Classification

Code

100 Head
- 110 Brain
- 120 Ear(s)
  - 121 Ear(s) External
  - 124 Ear(s) Internal (include hearing)
- 130 Eye(s) (include optic nerves and vision)
- 140 Face
  - 141 Jaw (include chin)
  - 144 Mouth (include lips,teeth,tongue,throat,and taste)
  - 146 Nose (include nasal passages,sinus,and sense of smell)

---

*NEC = Not elsewhere identified

A1.2

Part of Body Affected Classification / 353

148 Face,multiple parts (any combination of above parts)
149 Face,NEC

150 Scalp
160 Skull
198 Head,multiple(any combination of above parts)
199 Head,NEC

200 Neck

300 Upper extremities
310 Arm(s) (above wrist)
311 Upper arm
313 Elbow
315 Forearm
318 Arm,multiple (any combination of above parts)
319 Arm,NEC

320 Wrist
330 Hand (not wrist or fingers)
340 Finger(s)
398 Upper extremities,multiple (any combination of above parts)
399 Upper extremities,NEC

400 Trunk
410 Bdomen (include internal organs)
420 Back (include back muscles,spine,and spinal cord)
430 Chest (include ribs,breast bone,and internal organs of the chest)
440 Hips(include pelvis,pelvic organs,and buttocks)
450 Shoulder(s)
498 Trunk,multiple(any combination of above parts)
499 Trunk,NEC

500 Lower extremities
510 Leg(s) (above ankle)
511 Thigh
513 Knee
515 Lower leg
518 Leg,multiple(any combination of above parts)
519 Leg,NEC

520 Ankle
530 Foot (not ankle or toes)
540 Toe(s)
598 Lower extremities,multiple (any combination of above parts)
599 Lower extremities,NEC

700 Multiple parts (Applies when more than one major body part has been affected,such as an arm and a leg)

800 Body system(Applies when the functioning of an entire body system has been affected without specific injury to any other part,as in the case of poisoning,corrosive action affecting internal organs, damage to nerve centers,etc. Does not apply when the systemic damage results from an external injury affecting an external part such as a back injury which includes damage to the nerves of the spinal cord)

801 Circulatory system (heart,blood,arteries,veins,etc)

810 Digestive system

820 Excretory system (kidneys,bladder,intestines,etc)
830 Musculo-skeletal system (bones,joints,tendons,muscles,etc)
840 Nervous system
850 Respiratory system (Lungs,etc)
880 Other body systems

900 Body parts, NEC

999 Unclassified (insufficient information to identify part affected)

A1.3 Source of Injury Classification

A1.3.1 The Basic Classifications

Code

0100 Air pressure (abnormal environmental)
0200 Animals,insects,birds,reptiles (live)
0300 Animal products (not food)
0400 Bodily motion (no lifting,pulling,pushing,etc. See rule 3.3.2.3)
0500 Boilers,pressure vessels
0600 Boxes,barrels,containers,packages (empty or full)
0700 Buildings and structures(not floors,working surfaces,or walkways. See working suraces)
0800 Ceramic items,NEC
0900 Chemicals,chemical compounds (solids,liquids,gases)
1000 Clothing,apparel,shoes
1100 Coal and petroleum products
1200 Cold (atmospheric,environmental)
1300 Conveyors
1400 Drugs and medicines
1500 Electric apparatus
1700 Flame,fire,smoke
1800 Food products (including animal foods)
1900 Furniture,fixtures,furnishings (not fixed parts of buildings or structures)
2000 Glass items,NEC (glassware,glass fibers,sheets,etc,not bottles, jars,flasks,or glass cloth)
2200 Hand tools,not powered
2300 Hand tools,powered
2400 Heat,atmospheric,environmental (not hot objects or substances)

A1.3

Source of Injury Classification / 355

2500 Heating equipment,NEC(furnaces,retorts,space heaters,stoves,ranges, etc-not electric)

820 Excretory system (kidneys,bladder,intestines,etc)
830 Musculo-skeletal system (bones,joints,tendons,muscles,etc)
840 Nervous system
850 Respiratory system (Lungs,etc)
880 Other body systems

900 Body parts, NEC

999 Unclassified (insufficient information to identify part affected)

A1.3 Source of Injury Classification

A1.3.1 The Basic Classifications

Code

0100 Air pressure (abnormal environmental)
0200 Animals,insects,birds,reptiles (live)
0300 Animal products (not food)
0400 Bodily motion (no lifting,pulling,pushing,etc. See rule 3.3.2.3)
0500 Boilers,pressure vessels
0600 Boxes,barrels,containers,packages (empty or full)
0700 Buildings and structures(not floors,working surfaces,or walkways. See working suraces)
0800 Ceramic items,NEC
0900 Chemicals,chemical compounds (solids,liquids,gases)
1000 Clothing,apparel,shoes
1100 Coal and petroleum products
1200 Cold (atmospheric,environmental)
1300 Conveyors
1400 Drugs and medicines
1500 Electric apparatus
1700 Flame,fire,smoke
1800 Food products (including animal foods)
1900 Furniture,fixtures,furnishings (not fixed parts of buildings or structures)
2000 Glass items,NEC (glassware,glass fibers,sheets,etc,not bottles, jars,flasks,or glass cloth)

356 / Selected Codes from ANSI Z16.2-1962(R1969)

A1.4 Accident Type Classification

000-199 Accidents other than motor-vehicle or public transportation accidents

Code

010 Struck against
- 011 Stationary object
- 012 Moving object

020 Struck by
- 021 Falling object
- 022 Flying object
- 029 Struck by,NEC

030 Fall from elevation
- 031 From scaffolds,walkways, platforms,etc
- 032 From ladders
- 033 From piled materials
- 034 From vehicles
- 035 On stairs
- 036 Into shafts,excavations,floor openings,etc(from edge of opening)
- 039 Fall to lower level,NEC

050 Fall on same level
- 051 Fall to the walkway or working surface
- 052 Fall onto or against objects
- 059 Fall on same level,NEC

060 Caught in,under,or between
- 061 Inrunning or meshing objects
- 062 A moving and a stationary object
- 063 Two or more moving (not meshing)objects
- 064 Collapsing materials (sides of earth,collapse of buildings,etc)
- 069 Caught in,under,or between,NEC

080 Rubbed or abraded
- 081 By leaning,kneeling,or sitting on objects (not vibrating)
- 082 By objects being handled (not vibrating)
- 083 By vibrating objects
- 084 By foreign matter in eyes
- 085 By repetition of pressure
- 089 Rubbed or abraded,NEC

100 Bodily reaction
- 101 From involuntary motions
- 102 From voluntary motions

120 Overexertion
- 121 In lifting objects
- 122 In pulling or pushing objects
- 123 In wielding or throwing objects
- 129 Overexertion,NEC

130 Contact with electric current

A1.5

Hazardous Condition Classification / 357

150 Contact with temperature extremes
- 151 General heat-atmosphere or environment
- 152 General cold-atmosphere or environment
- 153 Hot objects or substances
- 154 Cold objects or substances

180 Contact with radiations,caustics,toxic and noxious substances
- 181 By inhalation
- 182 By ingestion
- 183 By absorption
- 189 NEC

200 Public transportation accidents (Code for type of vehicle in which injured was a pasenger)
- 201 Aircraft accident
- 203 Bus accident
- 205 Ship or boat accident
- 207 Streetcar or subway accident
- 209 Taxi accident
- 211 Train accident
- 298 Public vehicle accident,NEC

300 Motor-vehicle accidents (Code in terms of the event affecting or involving the vehicle in which the injured was an occupant. If more than one of the listed events occurred,code for the first event in the sequence)
- 310 Collision or sideswipe with another vehicle-both vehicles in motion
  - 311 With an oncoming vehicle on same road,street,or trafficway
  - 312 With a vehicle moving in same direcdtion on same road,street, or trafficway
  - 313 With a vehicle moving in an intersecting trafficway
- 320 Collision or sideswipe with a standing vehicle or stationary object
  - 321 Running into or sideswiping a standing vehicle or object in the roadway
  - 322 Running into or sideswiping a standing vehicle or object at side of road (not in trafficway)
  - 323 Struck by another vehicle while standing in roadway
  - 324 Struck by another vehicle while standing off the roadway
- 330 Noncollision accidents
  - 331 Overturned
  - 332 Ran off roadway (out of control)
  - 333 Sudden stop or start (throwing occupants out of,or against interior parts of the vehicle; or throwing contents of vehicle against occupants)
  - ff(Other noncollision accidents

899 Accident type,NEC

999 Unclassified,insufficient data

A1.5 Hazardous Condition Classification

NOTE: Selection of the hazardous condition which causedor permitted the occurrence of the accident does not involve a determination of the feasibility of correcting or eliminating the named condition.

Code

000 Defects of agencies (ie.undesired and unintended characteristics, generally the opposite of the desirable and proper characteristic, such as being dull when it should be sharp. Do not classify an intended and necessary characteristic of an agency as a defect. For example: A knife is expected to be sharp and is not defective because it has this characteristic)

001 Composed of unsuitable materials
005 Dull
010 Improperly compounded,constructed,or assembled
015 Improperly designed
020 Rough
025 Sharp
030 Slippery
035 Worn,cracked,frayed,broken,etc
099 Other defects,NEC

100 Dress or apparel hazards

NOTE: Name this hazardous condition if it,in fact,contributed to the occurrence of the accident even though the condition was created by the injured employee's own choice or unsafe act.

110 Lack of necessary personal protective equipment

NOTE: Name this hazard only when the personal protective equipment constitutes an essential element in the safe performance of the activity. Does not apply when the use of the protective equipment would merely have minimized the injury without preventing the accident.

113 Improper or inadequate clothing
199 Dress or apparel hazards,NEC

200 Environmental hazards,NEC

NOTE: These are general hazards of the workplace which commonly affect everyone in the area regardless of his assignment. They should be named as the accident cause only when none of the other more specific hazardous condition designations apply.

205 Excessive noise
210 Inadequate aisle space,exits,etc
220 Inadequate clearance (for moving objects or persons)
230 Inadequate traffic control (on employers' premises only-refers to maintenance of traffic lanes: elimination of blind corners, etc; control of speeding; direction of traffic away from danger points,etc)
240 Inadequate ventilation (general-not due to defective equipment)
250 Insufficient workspace
260 Improper illumination (Insufficient light for the operation,glare,e
299 Environmental hazards,NEC

300 Hazardous methods or procedures
(Caution should be observed in the application of this classification, particularly to avoid its becoming a "catch-all" for cases which cannot be assigned to other specific classifications because of inadequate information. It is not intended that an activity should be classified as a hazardous procedure simply because an injury or injuries occurred in the course of that activity. A hazardous method or procedure in this context is usually a deviation from the normal and generally accepted

safe procedures commonly applied in industrial operation. In some respects, this classification parallels the unsafe act classidication The distinguishing characteristic is that the procedures classified here were planned,directed, or condoned by supervision.)

310 Use of inherently hazardous (not defective)material or equipment
320 Use of inherently hazardous methods or procedures
330 Use of inadequate(not defective) or improper tools or equipment
340 Inadequate help for heavy lifting, etc.
350 Improper assignment of personnel(i.e disregard of physical limitations, skill. etc.)
399 Hazardous Methods or procedures, NEC

400 Placement hazards(mateials,equipment,etc-not person)
410 Improperly piled (refers to manner of piling)
420 Improperly placed (refers to position occupied)
430 Inadequately secured against undesired motion (not unstable piling)

500 Inadequately guarded
510 Unguarded (mechanical or physical hazards-not electrical or radiation hazards)
520 Inadequately guarded(mechanical or physical hazards-not electrical or radiation hazards)
530 Lack of or inadequate shoring in mining,excavating,construction,etc
540 Ungrounded (electrical)
550 Uninsulated (electrical)
560 Uncovered connections,switches,etc (electrical)
570 Unshielded (radiation)
580 Inadequately shielded (radiation)
590 Unlabeled or inadequately labeled materials
599 Inadequately guarded,NEC

600 Hazards of outside work environments-other than public hazards (encountered while working in or on premises not controlled by the employer and not arising from the activities of the injured or his co-employees or from the tools,materials,or equipment used in those activities)
610 Defective premises of others
620 Defective materials or equipment of others
630 Other hazards associated with property or operations of others
640 Natural hazards (i.e.hazards of irregular and unstable terrain; exposure to the elements,wild animals,etc;encountered in open country operations but not in cleared or regularly designated work areas)

700 Public hazards (encountered in public places away from employers' premises)
710 Public transportation hazards (encountered while a passenger is on a public carrier)
720 Traffic hazards (encountered on public streets,roads,or highways)
780 Other public hazards (other hazards of public places to which the general public is also exposed)

980 Hazardous conditions,NEC

990 Undetermined-insufficient information

999 No hazardous condition

360 / Selected Codes from ANSI Z16.2.1962 (R1969)

App. 1

A1. 8 Unsafe Act Classification

Code

050 Cleaning,oiling,adjusting,or repairing of moving,electrically energized,or pressurized equipment (Do not include actions directed by supervision)
- 051 Caulking,packing,etc,of equipment under pressure(pressure vessels,valves,joints,pipes,fittings,etc)
- 052 Cleaning,oiling,adjusting,etc,of moving equipment
- 056 Welding,repairing,etc,of tanks,containers,or equipment without supervisory clearance in respect to the presence of dangerous vapors,chemicals,etc
- 057 Working on electrically charged equipment (motors,generators,lines, etc)
- 059 NEC

100 Failure to use available personal protective equipment (goggles, gloves,masks,aprons,hats,lifelines,shoes,etc)

150 Failure to wear safe personal attire (wearing high heels,loose hair, long sleeves,loose clothing,etc)

200 Failure to secure or warn
- 201 Failure to lock,block,or secure vehicles,switches,valves,press rams,other tools,materials,and equipment against unexpected motion,flow of electric current,steam,etc
- 202 Failure to shut off equipment not in use
- 203 Failure to place warning signs,signals,tags,etc
- 205 Releasing or moving loads,etc,without giving adequate warning
- 207 Starting or stopping plant vehicles or equipment without giving adequate warning
- 209 NEC

250 Harseplay (distracting,teasing,abusing,startling,quarreling,practical joking,throwing material,showing off,etc)

300 Improper use of equipment
- 301 Use of material or equipment in a manner for which it was not intended
- 305 Overloading (vehicles,scaffolds,etc)
- 309 NEC

350 Improper use of hands or body parts
- 353 Gripping objects insecurely
- 355 Taking wrong hold of objects
- 356 Using hands instead of hand tools (to feed,clean,adjust,repair,etc)
- 359 NEC

400 Inattention to footing or surroundings

450 Making safety devices inoperative
- 452 Blocking,plugging,tying,etc,of safety devices
- 453 Disconnecting or removing safety devices
- 454 Misadjusting safety devices
- 456 Replacing safety devices with those of improper capacity (e.g.higher amperage electric fuses,low capacity safety valves,etc)
- 459 NEC

A1.8

Unsafe Act Classification / 361

500 Operating or working at unsafe speed
- 502 Feeding or supplying too rapidly
- 503 Jumping from elevations (vehicles,platforms,etc)
- 505 Operating plant vehicles at unsafe speed
- 506 Running
- 508 Throwing material instead of carrying or passing it
- 509 NEC

550 Taking unsafe position or posture
- 552 Entering tanks,bins,or other enclosed spaces without proper supervisory clearance
- 555 Riding in unsafe position (e.g.on platforms,tailboards,on running boards of vehicles;on forks of lift truck;on hook of crane;etc)
- 556 Unnecessary exposure undersuspended loads
- 557 Unnecessary exposure to swinging loads
- 558 Unnecessary exposure to moving materials or equipment
- 559 NEC

600 Driving errors (by vehicle operator on public roadways)
- 601 Driving too fast or too slowly
- 602 Entering or leaving vehicle on traffic side
- 603 Failure to signal when stopping,turning,backing
- 604 Failure to yield right of way
- 605 Failure to obey traffic control signs or signals
- 606 Following too closely
- 607 Improper passing
- 608 Turn from wrong lane
- 609 NEC

650 Unsafe placing,mixing,combining,etc
- 653 Injecting,mixing,or combining one substance with another so that explosion,fire,or other hazard is created (e.g.injecting cold water into hot boiler,pouring water into acid,etc)
- 655 Unsafe placing of vehicles or material moving equipment (i.e. parking,placing,stopping,or leaving vehicles,elevators,or conveying apparatus in unsafe position for loading or unloading)
- 657 Unsafe placement of materials,tools,scrap,etc (i.e.so as to create tripping,bumping,slipping hazards,etc)
- 659 NEC

750 Using unsafe equipment (e.g.equipment tagged as defective or obviously defective. Do not include the use of inherently hazardous material for its intended purpose unless it was obviously defective. Do not include use of defective material or equipment when the defect was hidden and not obvious to the user)

900 Unsafe act,NEC

993 No unsafe act

999 Unclassified-inadequate data

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DECLARATION

I, the undersigned, declare that this thesis is my work and that all sources of material used for this thesis have been duly acknowledged.

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