

OCCUPATIONAL INJURIES
IN THE
GENERAL BUILDING & HEAVY CONSTRUCTION INDUSTRIES
FINAL REPORT

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ABSTRACT

This study was conducted to identify significant hazards and recommend solutions to reduce the injury and severity rates in the General Building and Heavy Construction Industries (SIC 15 and 16). The study involved preparation of a digest of Federal and State regulations pertinent to the study area as well as an evaluation of the magnitude of the relevant safety problems. Actual accident/injury case records were reviewed to identify causal factors and to determine extent of OSHA coverage.

Findings of the overall study resulted in recommendations for new or revised regulations and/or standards promulgation in the following five categories:

- Education and Training
- Protective Headgear (Hard Hats)
- Medical Screening
- Scaffolding
- Safety Nets

CHAPTER I

INTRODUCTION

A. Purpose

The purpose of this study is to prepare a meaningful safe work practices document which identifies significant hazards and recommends solutions to reduce the injury and severity rates in the General Building and Highway Construction Industries (SIC 15 and 16). Implementation of these recommended solutions may be through promulgation of standards or regulations, or by alterations in the pattern of OSHA enforcement of existing regulations.

B. Background

NIOSH data indicate that historically the building and highway construction industries have had high rates for both incidence and severity of injuries. Standard Industrial Classification (SIC) 15, "General Building Contractors," appears as one of the industries with the greatest need for upgrading its safety standards. Highway and Street construction within SIC Group 16 also shows need for improved standards. Other NIOSH studies have indicated a similar urgency with respect to reducing the accident rate and hopefully the level of severity in the process.

These industries (SIC 15 and 16) contain a myriad of potential accident circumstance profiles due to the constant interaction between the environment, the workers, and machinery. The impact of lost-time injuries affects the economy, society, and, more importantly, the worker and his family.

This study was undertaken to examine the accidents in these two major industrial groups to determine causal factors involved so as to permit meaningful corrective action to be initiated to reduce frequency and severity of worker injuries. A separately contracted NIOSH study was initiated to ascertain the causal factors of accidents in two closely related specialized construction activities: excavation and trench shoring. These activities are usually incorporated into SIC Groups 15 and 16, but the nature of the hazards conveniently lend themselves to a separate study. Accidents related to these two activities were therefore not investigated in depth in this study but only reported as they were encountered in the data search.

C. Scope

The scope of the overall project is to identify significant hazards and recommend solutions to reduce the injury and severity rates in the SIC 15 and 16 industries. The project encompassed five separate phases, as follows:

- Phase I - Conduct a review and prepare a digest of all Federal and State laws, regulations, and standards pertinent to this study of the Occupational Injuries in the General Building and Heavy Construction Industries, SIC 15 and 16.
- Phase II - Evaluate the magnitude of the safety problem by determining number of workers and occupations at risk, and the number, types, frequency and severity of accidents in these industries (SIC 15 and 16) over the most recent five-year period for which data are available.
- Phase III - Perform in-depth investigations of a selected sample of recent accident/injury cases, assemble pertinent information, conduct a detailed analysis of these accidents, provide a description of the circumstances which may have been responsible for the mishap, and identify causal factors present.
- Phase IV - Identify, to the degree possible, each accident investigated in conjunction with Phase III according to the following categories:
 - There was a violation of an applicable OSHA regulation that was instrumental in the occurrence of the accident.
 - The accident occurred but no applicable existing OSHA regulation was violated.
 - The accident occurred but no OSHA regulation existed that would have related to its occurrence.
- Phase V - Prepare a final report which identifies significant hazards and recommends solutions which could then be implemented through regulations or standards.

D. Organization

Chapter II presents a discussion of each of the four phases of this study which form the background for the recommendations to reduce the injury and severity rates in the SIC 15 and 16 industries. For each phase of the study, the following items are addressed:

- Purpose
- Scope
- Approach
- Results

Chapter III presents a discussion of the five problem areas identified, and Chapter IV presents the recommendations for new or revised regulations and/or standards promulgation.

CHAPTER II

ANALYSIS

A. Introduction

During this study to identify significant hazards and recommend solutions to reduce the injury and severity rates in the SIC 15 and 16 industries, the following were accomplished:

- A review of pertinent laws, regulations, and standards.
- An evaluation of the magnitude of the safety problem.
- In-depth investigations of accident/injury cases.
- Identification of accidents investigated according to OSHA coverage.

Each of the above represents a separate phase of the study and is discussed in the following sections.

B. Review of Pertinent Laws, Regulations, and Standards

1. Purpose

The purpose of the initial phase of this study was to examine a restricted area, the highway construction and heavy construction industries (SIC codes 15 and 16) and determine: (1) which States have promulgated regulations that differ from the Federal regulations; (2) which Federal regulations have the states taken exception to; and (3) where do the States feel that additional regulations need to be promulgated.

2. Scope

Early in the study, certain decisions were made on the scope of the project and the basic approach that would be taken. The first was that attention would be restricted to standards and regulations in effect on January 1, 1977. The study would not attempt to address legislative efforts or standards which are under consideration, recommended, being revised, or otherwise in a state of transition or implementation.

The second major decision was that only those standards promulgated under Section 6 of the Act as noted in 29 CFR 1926 would be used as a basis for analyses. Standards cited elsewhere (e.g., 29 CFR Part 1910, 10 CFR Part 20, 49 CFR Part 178, etc.) are incorporated by reference in 29 CFR 1926, Occupational Safety and Health Regulations for Construction; thus, any changes in the standards referenced are

considered to be changed for the purpose of the cited standard and apply under Part 1926.

The third major decision was that the State plans, as filed with the Occupational Safety and Health Administration, Department of Labor, would constitute the primary source of information for comparative analyses. The States may be considered as falling into one of the following groups:

- I. No State plan has been submitted or a plan has been submitted and withdrawn.
- II. A State plan has been submitted but has yet to receive approval.
- III. A State plan has been submitted and approved. The State has either:
 - a. Made no change in any standard, or
 - b. Has implemented at least one standard which is different from the Federal standards.

For Groups I and II, the Federal standards apply and the development and enforcement of standards remains in the hands of the Federal Government. States in Group III.a. have elected to undertake the development and enforcement of standards themselves, but have submitted no materials in their State plans which indicate any difference in the standards from the Federal. States in Group III.b., on the other hand, have not only elected to undertake the development and enforcement of standards but have also submitted materials indicating that the States have enacted standards which differ from the Federal. Furthermore, each State presents its rationale for claiming that its standards are "at least as effective" as the Federal standards. That the claims have been accepted, after careful review, is attested to by the approval of the State plan. Thus, having undergone two prior reviews, the analyses presented in the State plans offer the most valid information available for the purposes of this study.

3. Approach

Identification of the States which have enacted regulations different from, or in addition to, the Federal regulations as presented in 29 CFR 1926, was made through the State plans that have been approved and published in 29 CFR 1952. They are: Alaska, California, Hawaii, Michigan, Oregon, and Washington. Confirmation of the identity of the six States was obtained from the Office of Federal and State Operations, OSHA, Department of Labor.

Identification of the specific variances enacted was accomplished by using the materials* submitted by the States in obtaining the approval of their State plans.

A matrix was constructed which contains seven columns. The first column, Reference Code, contains a footnote reference number (where applicable) to identify an outside source cited in the State plans. The referenced sources are identified at the end of the matrix.

The second column, Federal Regulation, is used to represent all of the States that had elected to adopt the Federal standards, in toto, or had not received approval of proposed changes and were still subject to the terms of 29 CFR 1926 as of January 1, 1977. Each of the remaining six columns is used to represent one of the six States identified on the preceding page.

In the matrix, the entry in the Federal Regulation column is the number of the CFR paragraph. The entries in the remaining columns are as follows--if the State had made no changes in the Federal standard, no entry was made in the column for that State opposite the paragraph number of the section in 29 CFR 1926. If the State had enacted a new or "more effective" standard, a code was entered as follows:

Code 1

Any change which was an additional requirement over and above the Federal regulation, i.e., any State regulation for which there was no corresponding Federal regulation.

Code 2

Any change which altered the effectiveness of a Federal regulation and made the regulation, in the State's opinion, "more effective" or "more restrictive" than the corresponding Federal regulation.

Code 3

Any change which cited a source outside of the submitted State materials, and the source was not readily available for comparison. If the source was available, the comparison was made and placed into the proper category of either code 1 or 2.

The completed matrix for this phase of the study appears as Appendix A to this report.

* Specifically, the "Comparisons of Federal and State Standards" submitted as appendices to the State plans.

4. Results

Six States have been identified which have promulgated standards different from the Federal standards. The type of variance has been identified according to whether:

- The State has enacted a new standard imposing requirements over and above those defined in 29 CFR 1926.
- The State has modified an existing Federal standard to make it "more effective."
- The State has enacted a standard which varies from the Federal standard and has cited a source external to either the Federal or State standards, i.e., "The California State Highway Code."

Analysis of the results obtained has shown that approximately 70% of the variances noted were modifications of existing Federal standards and 24% were additions to existing Federal standards. It was further observed that 45% of all the changes enacted occurred in the following areas of Part 1926:

- Subpart D - Occupational Health and Environmental Controls
- Subpart L - Ladders and Scaffolding
- Subpart N - Cranes, Derricks, Hoists, Elevators, and Conveyors
- Subpart U - Blasting and Explosives
- Subpart V - Power Transmission and Distribution

Furthermore, it was observed that the changes enacted by each of the six States tended to cluster in different subparts with the sole exception of Subpart U which drew attention from three of the States. The areas receiving most attention by each State were as follows:

- Alaska - Subpart L - Ladders and Scaffolding
- California - Subpart U - Blasting and Explosives
- Hawaii - Subpart U - Blasting and Explosives
- Michigan - Subpart C - General Safety and Health
- Oregon - Subpart L - Ladders and Scaffolding
- Washington - Subpart U - Blasting and Explosives

C. Evaluation of the Magnitude of the Safety Problem

1. Purpose

The purpose of the second phase of the study was to evaluate the magnitude of the safety problem in the SIC 15 and 16 industries by determining the number of workers and occupations at risk, and the number, types, frequency, and severity of accidents in these industries over the most recent five-year period for which data are available.

2. Scope

The time period selected for analysis was 1972 through 1976. This represents the only five-year period for which complete data are available. Currently, 1976 is the year for which the most recent data were available; prior to 1972, complete data were not furnished by the States to the newly-formed Occupational Safety and Health Administration. Specific information provided in this report includes:

- Number of workers at risk.
- Number of illnesses and injuries.
- Total case incidence rate.
- Lost workday case rate.
- Nonfatal without lost workday case incidence rate.
- Average lost workdays per lost workday case.
- Number of lost workday cases.
- Occupations with the highest frequency of accidents.
- Type of accidents with highest incidence of occurrence.

3. Approach

At present, there is no single source which provides enough in-depth information to permit a complete evaluation of the safety problem in the construction industries. The available sources are either incomplete or not yet operational. These include the National Occupational Health Survey, the Supplemental Data System, and the National Safety Surveillance System.

The National Occupational Health Survey (NOHS) was conducted in 1972 on a statistical sample of workplaces. This source does not contain the in-depth information required for this study nor has it been updated since 1972. Primarily, NOHS concentrates on chemical hazards in the workplace rather than accidents and safety-related incidents.

The Supplemental Data System (SDS) consists of data tapes submitted by four States for calendar year 1975. Although negotiated agreements have been made with 30 other States to submit similar data, only one year's data for one State have been edited and made available.

The National Safety Surveillance System (NSSS) cannot be utilized because it is not yet operational.

This phase of the study compiled an interim source of data for study until other more comprehensive sources become available. The Bureau of Labor Statistics (BLS) and the Occupational Safety and Health Administration (OSHA) were extremely cooperative in making their own collections of data available to the study team.

4. Results

Tabulations of selected injury and illness statistics in the SIC 15 and 16 industries are presented in Table 1 for each year during the period 1972 through 1976. The upper half of the table presents data pertaining to the SIC 15 industries, while the lower half relates to the SIC 16 industries. The leftmost column provides a description of the types of measures of illness or injury data being presented and the three columns for each year show separate illness, injury, and total (illness plus injury) values. In the case of average lost workdays per lost workday case (measure number 6), the total average figures reflect the very large proportion of injuries compared with illnesses.

The relative frequencies of the occupations at risk, as reflected in available accident statistics, are presented separately for the SIC 15 and 16 industries in Table 2. The occupational codes and occupation descriptions provided are taken from the Census Code Occupation Classification.

The relative frequencies of types of accidents occurring within the SIC 15 and 16 industries are presented in Table 3. The accident type codes and accident type descriptions are based on ANSI Z16.2.

D. In-Depth Investigation of Accident/Injury Cases

1. Purpose

The effort during the third phase of the study was intended to provide in-depth information concerning accidental injuries occurring among workers in the General Building and Heavy Construction industries (SIC codes 15 and 16). Of specific concern are:

- Underlying contributory or causal factors.
- Interrelationships between identified factors and standards in existence.

Table 1
INJURY AND ILLNESS STATISTICS¹

TYPE OF MEASURE	1972			1973			1974			1975			1976		
	TLL	INJ	TOT	TLL	INJ	TOT	TLL	INJ	TOT	TLL	INJ	TOT	TLL	INJ	TOT
(1) Workers at Risk	N/A	N/A	1036500	N/A	N/A	1271800	N/A	N/A	1225600	N/A	N/A	1047900	N/A	N/A	1003600
(2) No. of illnesses, injuries	4,000	153800	157800	4,300	198000	202400	3,500	171800	175300	2,700	139500	142200	2,174	117406	119580
(3) Total case incidence rate	0.5	18.0	18.5	0.4	20.3	20.7	0.4	18.7	19.1	0.3	15.8	16.1	0.3	15.5	14.2
(4) Lost workday case incidence rate	0.1	5.6	5.7	0.2	5.9	6.1	0.1	5.6	5.7	0.2	5.0	5.2	0.1	5.1	5.2
(5) Nonfatal no lost workday	0.4	12.4	12.8	0.3	14.3	14.6	0.3	13.1	13.4	13	18	18	0.2	9.0	9.2
(6) Average lost workday/lost workday case	10	16	16	9	16	16	21	16	16	1,000	44700	45700	20	19	19
(7) No. lost workday cases	800	47900	48700	1,300	58000	59300	700	51400	52100				809	42386	43195

SIC 15

TYPE OF MEASURE

- (1) Workers at Risk
- (2) No. of illnesses, injuries
- (3) Total case incidence rate
- (4) Lost workday case incidence rate
- (5) Nonfatal no lost workday
- (6) Average lost workday/lost workday case
- (7) No. lost workday cases

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TYPE OF MEASURE	1972			1973			1974			1975			1976		
	TLL	INJ	TOT	TLL	INJ	TOT	TLL	INJ	TOT	TLL	INJ	TOT	TLL	INJ	TOT
(1) Workers at Risk	N/A	N/A	732400	N/A	N/A	762400	N/A	N/A	778100	N/A	N/A	692500	N/A	N/A	766900
(2) No. of illnesses, injuries	4,700	124300	129000	3,400	128900	132300	2,900	120500	123400	2,900	100300	103200	2,919	113409	116328
(3) Total case incidence rate	0.7	18.9	19.6	0.5	18.8	19.3	0.4	17.7	18.1	0.4	16.2	16.6	0.4	16.3	15.9
(4) Lost workday case incidence rate	0.2	5.9	6.1	0.1	6.0	6.1	0.2	5.8	7.0	0.2	5.8	6.0	0.1	5.4	5.2
(5) Nonfatal no lost workday	0.5	12.9	13.4	0.3	12.8	13.1	0.3	11.8	12.1	0.3	10.3	10.6	0.3	10.4	10.7
(6) Average lost workday/lost workday case	14	16	16	12	18	18	13	19	19	12	20	19	13	20	20
(7) No. lost workday cases	1,600	38500	40100	400	41100	42000	800	39800	40500	1,000	36200	37200	791	38569	39360

SIC 16

- (1) Workers at Risk
- (2) No. of illnesses, injuries
- (3) Total case incidence rate
- (4) Lost workday case incidence rate
- (5) Nonfatal no lost workday
- (6) Average lost workday/lost workday case
- (7) No. lost workday cases

¹ Occupational Injuries and Illnesses in the U. S. by Industry, 1972-1976, U. S. Department of Labor, Bureau of Labor Statistics.

Table 2
OCCUPATIONS AT RISK

<u>SIC 15</u>	<u>Occupational</u> ¹ <u>Code</u>	<u>Occupation</u>	<u>Relative</u> ² <u>Frequency</u>
General Building	415	Carpenters	50%
	751	Construction Laborers except Carpenters Helpers	21%
	245	Managers and Administrators	5%
	750	Carpenters Helpers	3%
	780	Miscellaneous Laborers	2%
	441	Blue Collar Worker Supervisors	2%
	550	Structural Metal Workers	2%
	510	Painters, Construction and Maintenance	2%
	421	Cement and Concrete Finishers	1%
	N/A	42 other occupations contributing less than 1% each	12%
			<u>100%</u>
 <u>SIC 16</u>			
Heavy Construction	751	Construction Laborers except Carpenters Helpers	36%
	436	Excavating, Grading and Road Machine Operators except Bulldozer	12%
	415	Carpenters	5%
	715	Truck Drivers	4%
	640	Mine Operatives	3%
	680	Welders and Flame Cutters	3%
	522	Plumbers and Pipe Fitters	3%
	481	Heavy Equipment Mechanics	2%
	433	Electric Power Line and Cable Installers and Repairers	2%
	780	Miscellaneous Laborers	2%
	441	Blue Collar Worker Supervisors	2%
	245	Managers and Administrators	2%
	412	Bulldozer Operators	2%
	550	Structural Metal Workers	1%
	492	Miscellaneous Mechanics and Repairers	1%
	694	Miscellaneous Operatives	1%
	N/A	51 other occupations contributing less than 1% each	19%
			<u>100%</u>

¹Source: Census Code Occupation Classification, U. S. Department of Commerce, Bureau of the Census, 1970.

²Source: Colorado and North Carolina Supplemental Data System Files, 1974.

Table 3
TYPES OF ACCIDENTS

<u>SIC 15</u>	<u>Code</u> ¹	<u>Accident Type</u>	<u>Relative</u> ² <u>Frequency</u>
General Building	020	Struck By	30.2%
	030	Fall From Elevation	16.3%
	120	Overexertion	15.7%
	010	Struck Against	12.2%
	050	Fall on Same Level	8.1%
	060	Caught In, Under or Between	6.7%
	100	Bodily Reaction	3.8%
	080	Rubbed or Abraded	2.1%
	150	Contact with Temperature Extremes	1.9%
	180	Contact with Radiations, Caustics, Toxic and Noxious Substances	1.2%
	300	Motor Vehicle Accidents	0.8%
	130	Contact with Electric Current	0.2%
	N/A	All Others	0.8%
			<u>100.0%</u>
<u>SIC 16</u> Heavy Construction	020	Struck By	34.4%
	120	Overexertion	13.1%
	030	Fall from Elevation	10.8%
	010	Struck Against	9.7%
	060	Caught In, Under or Between	9.3%
	050	Fall on Same Level	6.2%
	300	Motor Vehicle Accidents	3.8%
	100	Bodily Reaction	3.7%
	150	Contact with Temperature Extremes	3.6%
	080	Rubbed or Abraded	1.6%
	180	Contact with Radiations, Caustics, Toxic and Noxious Substances	1.5%
	130	Contact with Electric Current	0.5%
	N/A	All Others	1.8%
			<u>100.0%</u>

¹Source: ANSI Z16.2

²Source: Colorado and North Carolina Supplemental Data System Files, 1974.

2. Scope

This phase of the study included an analysis of the data collected to identify those clusters of environment/equipment/worker accidents which are associated with either high frequency or extreme severity of injuries. The identified clusters were examined to determine the level of risk of injury to workers exposed to the risks.

In those situations where a high risk factor is ascertained and where accident/injury data are available to permit identification of the workers at risk, sample accident/injury case records were selected for field investigation. The selection of cases to be examined through field investigation was based on SIC 15 and 16 accident/injury case records identified through the OSHA MIS. A representative sample of these cases was selected for investigation in order to identify the causal factors present.

3. Approach

OSHA has established and maintains a computerized Management Information System (MIS) which records data from various OSHA reporting forms pertaining to individual accidents (events). It was hoped, originally, that the information contained in the MIS could be used to establish a sampling frame for the selection of cases to be pursued in depth and also to provide an overall background of information which would assist in structuring an understanding of the major parameters' behavior, for sampling purposes, in the population under study. This was not forthcoming.

It was further hoped that an examination of the Supplementary Data System (SDS) might provide a broad geographic background of types of cases, incidence, and severity and that these could be used for a preliminary relationship study of differences between 18(b) and non-18(b) States, if such occurred. Unfortunately, it was found that the variability in reporting procedures among the States made such an evaluation impracticable.*

It was therefore concluded that the only available data which could be used, even though limited in scope, were data available through the OSHA MIS. In particular, that information from the OSHA-1 Form, Safety and Health or Accident Inspection Report Form, was used. This form is completed and filed by OSHA Compliance Officers after inspection visits that are related to those cases of the highest severity, i.e., those events which resulted in the death of one or more workers and/or those events which resulted in the injury of five or more workers.

* See, for example, Tables 2 and 3. It was originally hoped that two such sets of statistics could be generated; one for the 18(b) States and one for the non-18(b) States. This could have been done but, due to widely variant reporting practices, would have proven meaningless.

The OSHA MIS contains information which records accident data compiled from OSHA reporting forms. In order to obtain information to assist in identifying accident/injury case data in the SIC 15 and 16 industries for the years 1972 through 1976, a customized query of the OSHA MIS was requested. The resultant query report provided the following categories of information pertaining to specific accident/injury cases:

- SIC Code
- OSHA Region Code
- OSHA Area Code
- Inspection Identification Number
- Type of Injury Code
- Accident Type Code

The OSHA MIS query report provided accident/injury case data relating to 314 accident/injury cases involving 444 persons in the SIC 15 industry and 538 cases involving 698 persons in the SIC 16 industry.

The accident/injury cases identified through the OSHA MIS query formed the base from which individual case records were selected for review during the field investigation effort. The procedure followed was to use the MIS to identify those regional offices having the largest absolute numbers of recorded accidents between 1972 and 1976 inclusive.

Through the cooperation of OSHA Region and Area offices concerned, records were made available and a comprehensive review of selected accident/injury case records was accomplished and pertinent facts recorded for evaluation.

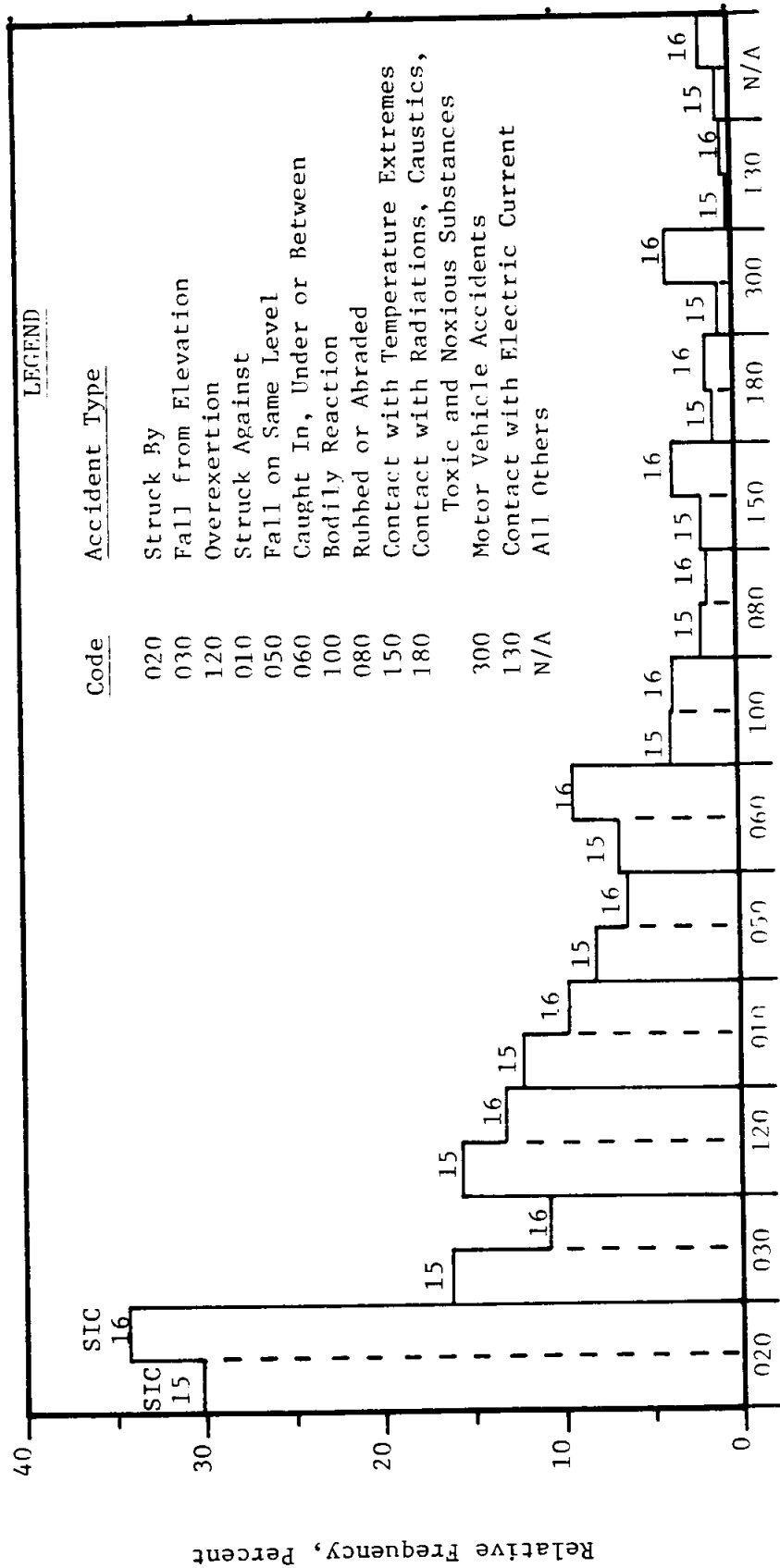
4. Results

An analysis of the accident/injury statistics in the SIC 15 and 16 industries for the period 1972 through 1976 provides frequencies of types of accidents occurring and occupations at risk. Figure 1 compares the relative frequencies of the most common types of accidents occurring within SIC 15 and 16. It is of interest to note that approximately 90 percent of the accident types within SIC 15 and nearly 85 percent of the accident types within SIC 16 are categorized by only six of the 15 major accident type classifications employed in ANSI Z16.2. The major accident type classification occurring within both the SIC 15 and 16 industries is "struck by," representing over 30 percent of the accident types occurring in each industry.*

* Case Reports 29, 151, 162, 220, 250, 317, 361, 421, 435, 448, 466, 471, 487, 926, H 3103 (see Table 5, Page 18)

Figure 1

Relative Frequencies of Accidents Occurring in SIC 15 and 16
Industries for Period 1972-1976



The occupations which appear to be at high risk in the SIC 15 and 16 industries represent only a small percentage (less than 8%) of the total occupations within these industries. Figure 2 presents a comparison of the relative frequencies of these occupations which are involved in accident/injury cases. Each of the four specific occupations compared is reflected in at least five percent of the accident/injury cases in the SIC 15 and/or SIC 16 industry.

As a result of the examination of the OSHA MIS data files, three geographic areas were selected for visitation, one in the Middle-Atlantic coastal area and two in the Southwest.

After careful review of 261 events, 46 were selected as typical for in-depth evaluation. The distribution of the selected cases, by type of event, type of injury, and occurrence of mortality, is shown in Table 4.

It is to be noted, first, that the overall mortality was 115/261, or a mortality rate (gross) of 44%. The highest mortality rate was in the category of "struck by/fracture." This, however, was followed closely by the category of "contact with electric current."

The most frequent type of event involved individuals "struck by" or "struck against." Both of these were overshadowed by the single category of falls. Altogether, these three categories accounted for 76% of the events investigated and 75% of the observed mortality.

Of the cases, 42% could not be identified from the information in the files, according to SIC code. Of the remainder, 76% were in SIC 16. Mortality ratios concerned, however, indicated that a mortality rate of 55% was associated with the events involving workers within SIC 16, while the mortality rate among the SIC 15 workers was 57%. Due to the small numbers involved, no significance can be attributed to this difference in mortality rates.

Overall, it is to be noted that nearly 40% of all injuries sustained were of the "crushing" type. These types of injuries normally lead to internal injuries and cardiac arrest, and this was borne out by the present study.*

A tabulation of the accident/injury case data recorded during the field investigation effort is presented in Table 5.

Examination of the causal factors underlying the occurrence of the events investigated lead to the inescapable conclusion that two basic factors are involved:

* Case Reports 29, 57, 151, 162, 189, 220, 245, 250, 317, 361, 419, 421, 424, 435, 437, 466, 471, 487, 926 (see Table, Page 18)

Figure 2

Relative Frequencies of Occupations at High Risk
in the SIC 15 and 16 Industries for Period 1972-1976

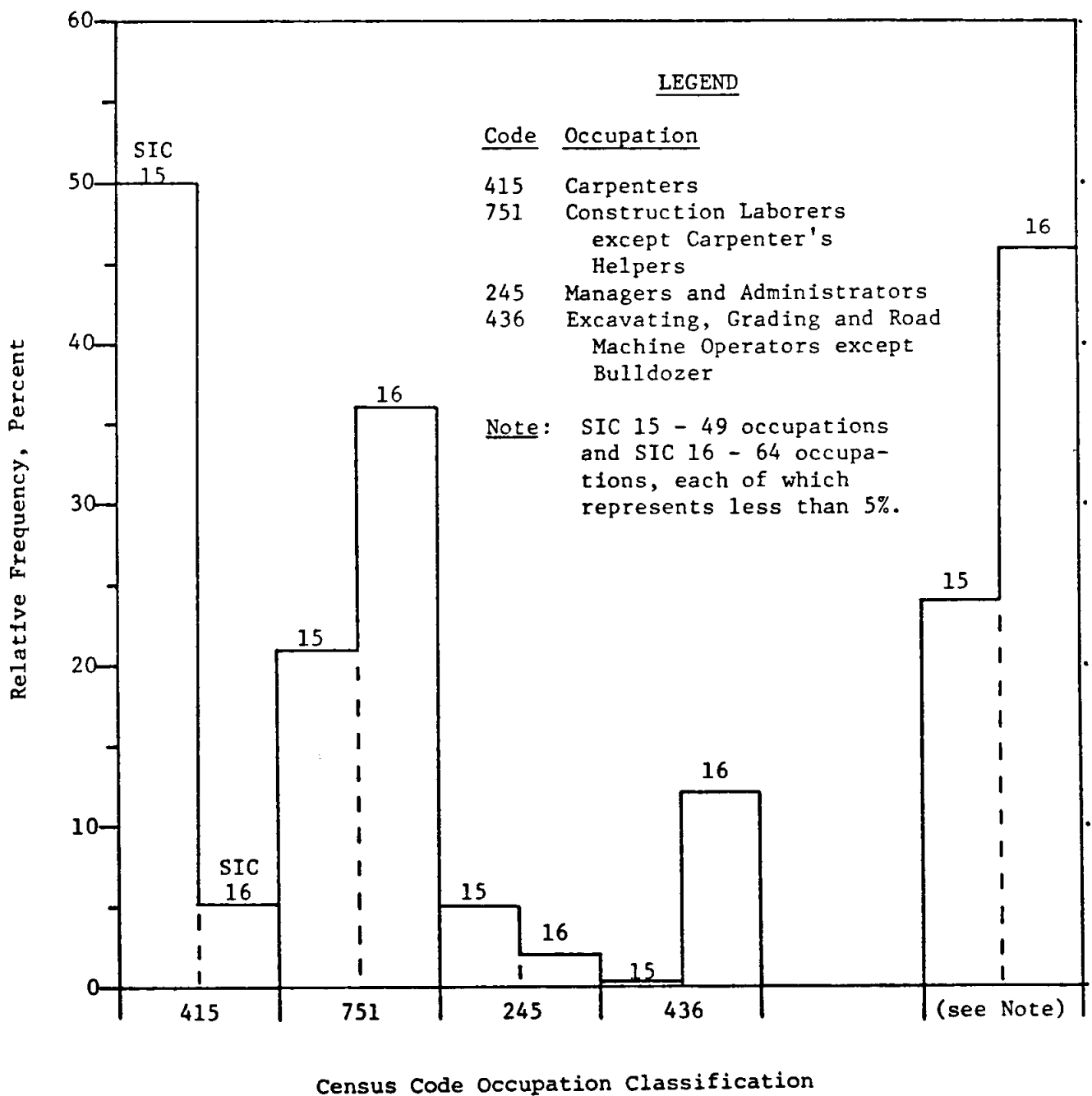


Table 4

Distribution of Selected Accident/Injury Cases
Reviewed during Field Investigation

EVENT* TYPE	INJURY TYPE							TOTAL
	2	4	6	10	12	17	21	
1	-	-	1/2	-	-	-	5/11	6/13
2	2/6	-	-	-	-	-	3/4	5/10
5	-	-	0/2	-	3/7	-	1/3	4/12
8	0/1	0/2	-	-	-	0/1	-	0/4
13	-	-	-	5/7	-	-	-	5/7
TOTAL	2/7	0/2	1/4	5/7	3/7	0/1	9/18	20/46

Note: Numbers referenced above are deaths/cases.

*Event type numbers refer to OSHA code designations.

TABLE 5 ACCIDENT/INJURY CASE DATA

Date Report #	Region/ Area & SIC #	Injury Type	Event Type	Description of Accident	Age of Victim	Comments
437	06/1730 1622	21	05	Employee wearing approved 90' lifeline which was too long to enable fellow employee assistance.	68	Lines should only be as long as necessary to prevent unnecessary fouling.
1/78 926	06/1730 1541	21	01	1 death, 1 injury from collapsed steel building when 5,000 lbs was placed on open web roof before all bridging and joists were permanently fastened (no safety belts provided).		Proper filling for concrete forms; permanent bridging or joists.
10/74 435	06/1730 1511	21	02 01	Scaffold roller rolled off fuel tank being filled, striking employee on head. Boatswain chair tackle was held by the insecurely anchored roller.	45	Rolling hanger should be supported securely. Safety life belt should be provided for tank painters.
11/75 391	06/3280 1621	02	02	Trench cave-in while crew was installing a concrete reinforced water line.		Proper shoring and sloping of trenches.
3/75 316	06/3280	12	05			Proper warnings, hazards must be conspicuously posted on all equipment.
5/76 487	1623	21 12	01 02 02	Brake failure on port stern drum due to sea movement.	61	
11/76 461	06/3280	12	05	Employee fell-no safety lines; net, etc. were not connected-scaffolding shifted (4-1/2" extension) and fell.		Protective equipment - lifelines, safety belts for 330,307 ft. elevation. Safety nets - 330,307 ft. Ladders for safe access. Proper scaffold planks extended 6-12".

TABLE 5 (Cont'd)

Date Report #	Region/ Area & SIC #	Injury Type	Event Type	Description of Accident	Age of Victim	Comments
8/78 605	06/1365 1629	10	13	Employees preparing to megger the 500 HP motor from starter cubicle (2400v) when a flash electrical fire occurred.	59	Grounding and deenergizing electric circuits. Proper insulated protective gloves. Posting of proper warning signs.
8/78 29	06/1365 1611	21	01	Older maintainer not covered by OSHA standards due to its vintage, had no-roll over protection. Driver crushed when rolled off a bank.		Non roll-over protected vehicles should not be allowed usage near slopes.
7/75 5/76 448	06/ * 1621	06	01	While mending frayed crane cable, remaining threads broke throwing cable into victim (had on hard hat).	31	
424	06/1730	21	05	Defective safety belt.		
6/74 135	06/ * 1621	10	13	Dragline connecting pipes came into contact w/wet tree limbs that were in contact w/electrical distribution line.		
8/78 161		04	08	Pipefitters. Diesel cherry picker used by gas employees changing valves in butadiene lines which still contained butadiene liquid and vapors - removed a valve from a line before it was ready - serious burns.		Educated supervisors who know of chemical hazards. Fire hazards posed by machinery (cherry picker) near flammable gases.
8/78 247	06/3280 1622	12	05	33.5 ft. stairway w/no platforms, open sides, no toe boards, collapsed when too many men came down at once.	54	Platforms above 6' from floor need guarded standard railing landings at every 12 ft. Barriers needed within swing radius of rotating crane. Accident prevention program. Accessible fire extinguisher. Employees should not be allowed to work under a suspended load. Operator of crawler crane should not leave.
* -	New Houston area office					

TABLE 5 (Cont'd)

Date Report #	Region/ Area & SIC #	Injury Type	Event Type	Description of Accident	Age of Victim	Comments
3/78 426	06/1730	10	13	Employee electrocuted when working on damaged 7,200v AC power line believed to have been deenergized.	23	Deenergized 7 grounded wires. Rubber gloves and protectors. Protective devices. First aid training and/or clinic nurse.
3/75 317	06/3280 1511	21	01	Pipefitter unloading structural steel I-beams unboomed the load which fell on him. I-beams slid off truck after being released.	42	Instructions, load capacities, operating speeds posted on all equipment. Cross members should be flat on truck bed.
10/74 97	06/3280	04 05	08 14	Men in manhole severely burned when pushing conduit through (flashfire) propane gas stored underground. Investigation showed live gas in hole.		Must test for flammable or toxic gases in manhole to be worked on.
12/77 421	06/1730 1622	21	01	Concrete forms being erected fell turning over 2 fork lifts. Relieved large gust of wind knocked over beam.	23	Platform on truck greater than 6' need railings. Safe supporting form work and bracing plans for job site. Safety platforms on industrial trucks. OSHA notice of protection and obligation. Hand signal instructions. Accessible fire extinguisher 5BC.
9/78 244	06/3280 1623	02	08	Worker died in sewer when plug came loose.		Safe means of access provided for working places in shafts and tunnels. Testing atmosphere for hazardous substances.
2/75 293	06/3280	10	13	Electrocuted when crawler crane came in contact w/an overhead power line.	53	

TABLE 5 (Cont'd)

Date Report #	Region/ Area & SIC #	Injury Type	Event Type	Description of Accident	Age of Victim	Comments
7/75 368	06/3280 1621	10	13	Man electrocuted from ungrounded welding machine frame or case.	28	Proper grounding of noncurrent carrying parts and also welding machine and frames grounded.
9/76 131	06/ * 1621	02	02	Trench wall cave-in✓		Proper shoring and sheeted, braced and sloped trenches. Proper soil.
11/75 394	06/3280 1621	10	13	Crane came in contact w/7200v line electrocuting workers holding bucket to be unloaded.	23	Min. clearance of 10 ft. between link belt crane and electrical lines. Guard rails on walkways. Proper shoring of trenches.
11/76 466	06/1730 1542	21	01	Employee not wearing safety belt, etc. while disengaging a gin pole which hung and lifted tower section off platform - tower struck employee - fell.	53	Safety belts and lanyards attached to lifelines or other supports needed.
10/75 700	06/1730 1511	12	05	Employee fell through scaffolding when he lost balance.		Portable equipment must be grounded. Floor holes must be guarded by standard railing and toeboard or cover.
10/78 162	06/1365	21	01	Dolly rolled off 11th floor and hit victim. Dolly shoved near unguarded edge.		Toeboards on open sided platforms. Guardrails w/top rail, intermediate, toeboard and posts.
11/74 250	06/ * 1511	21	01	Friction brake of crane did not hold; operator lost control of boom which fell on concrete structure and victim.		Boom failure due to inclement weather.
9/74 245	06/3280	02 21	02 12	While unclogging sewer line adjacent to hole it suddenly became unclogged, releasing methane gas. 2 fatalities, 3 injuries by being overcome with fumes.		Test for oxygen deficiency in manholes.
* - New	Houston area office					

TABLE 5 (Cont'd)

Date Report #	Region/ Area & SIC #	Injury Type	Event Type	Description of Accident	Age of Victim	Comments
12/74 259	06/3280 1621	10	13	Men unloading pipe from crane were electrocuted when it came in contact w/power line.		Post load capacities, operating speeds. Provide hand signal directions. Inspection record of hoisting machine. Min. clearance of 10 ft. between boom and power line.
10/74 189	06/3280 1611	21	02	Blind spot caused scraper to roll over on man.	58	
11/75 361	06/3280	21 03	01 02	Raised unblocked bed of a dump truck fell on man under truck, trapping him to the left beam of the torque of the truck.		Positive means of support permanently attached and capable of being locked in position.
10/76 520	06/3280 1623	02	02	Man in trench unhooking lower-in belt, and ditch bank caved in and struck legs.	34	Trench must be shored or sloped to prevent cave-ins. Warning vests for traffic directors.
5/76 57	1623	02 21	02	Wall of an excavation sloughed off, covering and crushing victim.		Proper shoring or sloped trench, along with adequate exits or escapes.
10/78 547	06/1365	21	02	Rolling pipes from double joint operation caught worker between girders and pipe picker.		Proper safety training. Written safe work practices. Prevent rolling pipes after the pipe picker has been released.
5/75 339	06/3280	17	08	While overhauling and repairing a reactor and a regenerator, employees were stricken with a respiratory type ailment from a chemical.		Report hospitalization of workers within 48 hrs. to OSHA.
1/76 419	06/3280	21 12	02	Worker crushed between the lefthand track and counterweight of a cab sized backhoe. Worker carelessness.	25	

TABLE 5 (Cont'd)

Date Report #	Region/ Area & SIC #	Injury Type	Event Type	Description of Accident	Age of Victim	Comments
3/78 40	06/3280 1542	12	05	While descending on a portable ladder, an employee untied the top of the ladder in order to move it to a new location and descended the ladder w/out securing it.	50	Proper tying, blocking, or securing of portable ladders.
7/74 220	06/3280 1621	21	05 01	Laborer fell off loader bucket and was crushed as the hoe ran over him.		
8/75 377	06/3280 1621	02 12	02	Stabilized shells shifted in a pit but workers were warned to stay out by foreman. Worker's own fault.	42	
8/74 151	06/3280 1611	21	01	Worker crushed when blade being unloaded slipped out of chain and chain whipped out and hit loader.		
6/76 471	06/3280 1611	21 03	01	Worker killed when he stepped in front of pneumatic roller.	56	
5/78 623	06/3280	12	05	Worker fell 26 ft. through plywood hatch cover at sewage treatment plant.	61	
12/74 H3103	03/0010	06	01	4x4x16' timber fell from 7th floor during stripping operation. Worker had been warned to stay away from area.		
1/76 S2650	03/0010	12	05	Accident due to the tipping over of the crane which was supporting the elevator shaft containing the workers.		Room of crane should not be over-extended.
4/75 B9754	03/0010	06	05	Serious violation cited - man working on 6 ft. high scaffold with no railings positioned adjacent to 8x8' floor opening.		Railings around elevated openings required.
5/76 H3103	03/0010	06	05	Worker killed when scaffold, which he had improperly erected, collapsed. (Not nailed completely).		Accurate and complete scaffold construction.

- Education and training.
- Directed supervision.

Education and Training

The single most important consideration which seems to emerge from the examination of the identified cases is that there was a singular lack of development and maintenance of the awareness of danger involved in the tasks being performed: development in the sense that the workers did not appear to have a full appreciation of the dangers inherent in the tasks which they were asked to perform, and maintenance in the sense that the workers were not provided adequate guidance about avoiding dangerous elements of those tasks on an on-going basis. This appears to be particularly true in the cases involving individuals who are "prone" to myocardial infarctions (MI's), i.e., those individuals with prior history of heart attacks or those in the age brackets where such incidents are most common.

As noted earlier, the most frequent types of injuries observed were those which lead to internal injuries and/or shock. Both of these circumstances contribute stress to the cardiovascular and central nervous systems. It is therefore not surprising to find a high frequency of MI's in both underlying causes of death and in prior histories of the individual workers involved. Of 261 reported cases, 109 or 42% were shown to have previous myocardial infarctions or prior histories of heart conditions. A glance at the age distributions shows a clear-cut bimodal distribution with peaks in the twenties and fiftys, with the preponderance of older workers showing either a history of MI or with MI listed as a contributory cause of death.

Directed Supervision

Among the incidents investigated, it was observed that nearly 40% were found by the investigators not to have involved any violation of existing standards. Instead, such notations as "worker's carelessness," "warned by foreman," "no fault found" were prevalent. It is interesting to note, however, that in 53% of the cases found to involve no violation, a fatality resulted.

It would appear that the investigator's attitude is akin to the parent who pleads, "I told her not to play with that gun, that I always keep it loaded." A simple warning to a worker is, obviously, not an adequate preventive measure. What is required is on-going, continuous supervision of the workers to insure that constant compliance is maintained.

E. Identify Accidents (Investigated) by OSHA Coverage

1. Purpose

The purpose of this phase was to present the results of the evaluation and identification of each of the accidents investigated during the preceding phase, according to the following categories:

- There was a violation of an applicable OSHA regulation that was instrumental in the occurrence of the accident.
- The accident occurred but no applicable existing OSHA regulation was violated.
- The accident occurred but no OSHA regulation existed that would have related to its occurrence.

2. Scope

This phase of the study included a review of the data collected during the field investigation to identify code violations and, where possible, to categorize the accident cases reviewed. The cases are categorized according to whether an OSHA regulation was violated, no applicable OSHA regulation was cited, or no OSHA regulation existed.

3. Approach

The accident/injury cases identified through an OSHA MIS query and subsequently examined during the field investigation efforts provided informational items required for the review and categorization of these mishaps according to OSHA regulation coverage. In addition, the identification and determination of underlying causal factors provides additional information concerning the accident/injury cases required for this phase of the study.

The following specific items of information pertaining to the accident/injury cases reviewed were further evaluated to assist in the categorization of the mishaps:

- State Where Accident Occurred
- Injury Type
- Accident Type
- Description of Accident
- Age of Victim (if reported)
- Code Violated (if any)
- Description of Circumstances Surrounding Mishap
- Causal Factors

Each accident/injury case examined was evaluated to ascertain, to the degree possible, if one of the following circumstances apply:

- There was a violation of an applicable OSHA regulation.
- There was no applicable existing OSHA regulation cited.
- No related OSHA regulation existed.

An attempt was made to identify each of the accidents investigated according to the three categories noted above. Each case so categorized is cross-indexed to the pertinent OSHA regulations (if any).

4. Results

The cases reviewed in depth during the field investigation efforts were identified according to the above noted categories of OSHA regulation coverage. Table 6, Accident/Injury Case Data, presents the data collected during the field review and includes (righthand column) a Code Violated notation, where appropriate, for each case evaluated.

In summary, for the 46 cases reviewed, approximately 61 percent (28 cases) were cited by the cognizant OSHA investigator as clear-cut violations of existing codes and regulations. Based on the OSHA investigator's findings for the remaining 39 percent, 13 cases (28 percent) involved no citation while the remaining five cases (11 percent) were not deemed covered by current regulations.

TABLE 6 ACCIDENT/INJURY CASE DATA

Date Report #	Region/ Area & SIC #	Injury Type	Event Type	Description of Accident	Age of Victim	Comments	Code Violated
437	06/1730 1622	21	05	Employee wearing approved 90' lifeline which was too long to enable fellow employee assistance.	68	Lines should only be as long as necessary to prevent unnecessary fouling.	
1/78 926	06/1730 1541	21	01	1 Death, 1 injury from collapsed steel building when 5,000 lbs was placed on open web roof before all bridging & joists were permanently fastened (no safety belts provided).		Proper filling for concrete forms; permanent bridging or joists.	Section 5(a)(1) OSHA Act 29 CFR 1926.28(a) Section 5(a)(1) 29 CFR 1926.751(b) (Rainy weather also)
10/74 435	06/1730 1511	21	02 01	Scaffold roller rolled off fuel tank being filled striking employee on head. Boatswain chair tackle was held by the in-securely anchored roller.	45	Rolling hanger should be supported securely. Safety life belt should be provided for tank painters.	29 CFR 1910.28(j)(6) 29 CFR 1910.28(j)(4)
11/75 391	06/3280 1621	02	02	Trench cave-in while crew was installing a concrete reinforced water line.		Proper shoring & sloping of trenches.	
3/75 316	06/3280	12	05			Proper warnings, hazards must be conspicuously posted on all equipment.	29 CFR 1926.550(a)(2) 29 CFR 1926.550(a)(14)(1) 29 CFR 1926.104(b)
5/76 487	1623	21 12	01 02 02	Brake failure on port stern drum do to sea movement.	61		No citation
11/76 461	06/3280	12	05	Employee fell-no safety lines; net, etc. were not connected - scaffolding shifted (4½" extension) and fell.		Protective equipment - lifelines, safety belts for 330, 307 ft. elevation. Safety nets - 330, 307 ft. Ladders for safe access. Proper scaffold planks extended 6-12"	29 CFR 1926.2 (a) 29 CFR 1926.105(a) 29 CFR 1926.450(a)(1) 29 CFR 1926.451(a)(14)
8/78 605	06/1365 1629	10	13	Employees preparing to meger the 500 HP motor from starter cubicle (2400v) when a flash electrical fire occurred.	59	Grounding & deenergizing electric circuits. Proper insulated protective gloves. Posting of proper warning signs.	29 CFR 1926.400(c)(1) 29 CFR 1926.400(c)(2) Section 5(a)(1) OSHA Act

TABLE 6 (Cont'd)

Date Report #	Region/ Area & SIC #	Injury Type	Event Type	Description of Accident	Age of Victim	Comments	Code Violated
8/78 29	06/1365 1611	21	01	Older maintainer not covered by OSHA standards due to its vintage, had no-roll over protection. Driver crushed when rolled off a bank.		Non roll-over protected vehicles should not be allowed usage near slopes.	
7/75 5/76 448	06/ * 1621	06	01	While mending frayed crane cable, remaining threads broke throwing cable into victim (had on hard hat).	31		No citation.
424	06/1730	21	05	Defective safety belt.			No citation.
6/74 135	06/ * 1621	10	13	Dragline connecting pipes came into contact w/wet tree limbs that were in contact w/electrical distribution line.			No violation of current standard.
8/78 161		04	08	Pipefitters. Diesel cherrypicker used by gas employees changing valves in butadiene lines which still contained butadiene liquid and vapors - removed a valve from a line before it was ready - serious burns.		Educated supervisors who know of chemical hazards. Fire hazards posed by machinery (cherrypicker) near flammable gases.	29 CFR 1926.21(b)(2)
8/78 247	06/3280 1622	12	05	33.5 ft. stairway w/no platforms, open sides, no toe boards, collapsed when too many men came down at once	54	Platforms above 6' from floor need guarded standard railing landings at every 12 ft. Barriers needed within swing radius of rotating crane. Accident prevention program Accessible fire extinguisher.	29 CFR 1926.500(d)(1) 29 CFR 1926.501(1) 29 CFR 1926.550(a)(9) 29 CFR 1926.550(a)(14)(1) 5(a)(1) OSHAAct 29 CFR 1926.20(b)(2) 29 CFR 1910.180(h)(4)(1) 29 CFR 1910.180(h)(4)(11)
6/78 247	06/3280 1622	12	05			Employees should not be allowed to work under a suspended load. Operator of crawler crane should not leave.	
3/78 426	06/1730	10	13	Employee electrocuted when working on damaged 7,200 v. AC power line believed to have been deenergized.	23	Deenergized 7 grounded wires. Rubber gloves & protectors. Protective devices. First aid training and/or clinic nr.	Sec. 5(a)(1) OSHAAct 29 CFR 1910.151(b)

* new Houston area office

TABLE 6 (Cont'd)

Date Report #	Region/ Area & SIC #	Injury Type	Event Type	Description of Accident	Age of Victim	Comments	Code Violated
3/75 317	06/3280 1511	21	01	Pipefitter unloading structural steel I-beams unhooked the load which fell on him. I-beams slid off truck after being released.	42	Instructions, load capacities, operating speeds posted on all equipment. Cross members should be flat on truck bed.	29 CFR 1926.550 (a)(2)
10/74 97	06/3280	04 05	08 14	Men in manhole severely burned when pushing conduit through (flashfire) propane gas stored underground. Investigation showed live gas in hole.		Must test for flammable or toxic gases in manhole to be worked on.	29 CFR 1926.800(c)(1)(1)
12/77 421	06/1730 1622	21	01	Concrete forms being erected fell turning over 2 fork lifts. Believed large gust of wind knocked over beam.	23	Platform on truck > 6' need railings Safe supporting form work & bracing plans for job site. Safety platforms on industrial trucks. OSHA Notice of protection & obligation. Hand signal instructions. Accessible fire extinguisher 5BC.	Sec. 5(a)(1) Public Law 91-596 29 CFR 1926.701(a)(2) " " " .602(c)(v1) ANSI B56.1-1969 29 CFR 1903.2(a)(1) " " 1926.550(a)(4) " " .550(a)(14)(1) Safety hazard not covered by standard.
9/78 244	06/3280 1623	02	08	Worker died in sewer when plug came loose.		Safe means of access provided for working places in shafts & tunnels. Testing atmosphere for hazardous substances.	29 CFR 1926.800(a)(2) " " " .800(c)(e)(1)
2/75 293	06/3280	10	13	Electrocuted when crawler crane came in contact w/an overhead power line.	53		
7/75 368	06/3280 1621	10	13	Man electrocuted from ungrounded welding machine frame or case.	28	Proper grounding of non-current carrying parts & also welding machine & frames grounded.	29 CFR 1926.401(a)(1) " " " .351(c)(5)
9/76 131	06/ * 1621	02	02	Trench wall cave-in.		Proper shoring & sheeted, braced & sloped trenches. Proper soil.	29 CFR 1926.652(b)

* new Houston area office

TABLE 6 (Cont'd)

Date Report #	Region/ Area & SIC #	Injury Type	Event Type	Description of Accident	Age of Victim	Comments	Code Violated
11/75 394	06/3280 1621	10	13	Crane came in contact w/7200v line elec- trocuting workers holding bucket to be unloaded.	23	Min. clearance of 10 ft. between link belt crane & electrical lines. Guard rails on walkways. Proper shoring of trenches.	29 CFR 1926.550(a)(15)(1) " " " .651(w) " " " .652(c)
11/76 466	06/1730 1542	21	01	Employee not wearing safety belt, etc. while disengaging a gin pole which hung & lifted tower section off platform - tower struck employee - fell.	53	Safety belts & lanyards attached to lifelines or other supports needed.	29 CFR 1926.28(a)
10/75 700	06/1730 1511	12	05	Employee fell through scaffolding when he lost balance.		Portable equipment must be grounded. Floor holes must be guarded by standard railing & toeboard or cover.	29 CFR 1926.401(a)(1) " " " .500(b)(8) No violation for accident (freak accident).
10/78 162	06/1365	21	01	Dolly rolled off 11th floor & hit victim. Dolly shoved near unguarded edge.		Toeboards on open sided platforms. Guardrails w/ top rail, intermed- iate, toeboard & posts.	29 CFR 1926.500(d)(1) " " " .500(f)(1)
11/74 250	06/ * 1511	21	01	Friction brake of crane did not hold; op- erator lost control of boom which fell on concrete structure & victim.		Boom failure due to inclement weather.	No citation.
9/74 245	06/3280	02 21	02 12	While unclogging sewer line adjacent to hole it suddenly became unclogged releas- ing methane gas. 2 fatalities, 3 injuries by being overcome with fumes.		Test for oxygen deficiency in man- holes.	29 CFR 1926.800(c)(1)(11) of Subpart S
12/74 259	06/3280 1621	10	13	Men unloading pipe from crane were elec- trocutted when it came in contact w/power line.		Post load capacities, operating speeds. Provide hand signal directions. Inspection record of hoisting machine. Min. clearance of 10 ft. between boom & power line.	29 CFR 1926.550(a)(2) 29 CFR 1926.550(a)(4) " " " .550 (a)(6) " " " .550(a)(13)(1)
10/74 189	06/3280 1611	21	02	Blind spot caused scraper to roll over on man.	58		No citation.

*New Houston area office

TABLE 6. (Cont'd)

Date Report #	Region/ Area & SIC #	Injury Type	Event Type	Description of Accident	Age of Victim	Comments	Code Violated
11/75 361	06/3280	21 03	01 02	Raised unblocked bed of a dump truck fell on man under truck trapping him to the left beam of the torque of the truck.		Positive means of support permanently attached & capable of being locked in position.	29 CFR 1926.601(b)(10)
10/76 520	06/3280 1623	02	02	Man in trench unhooking lower-in belt, and ditch bank caved in & struck legs.	34	Trench must be shored or sloped to prevent cave-ins. Warning vests for traffic directors.	29 CFR 1926.650(f) " " " .652(h) " " " .652(c)
5/76 57	1623	02 21	02	Wall of an excavation sloughed off covering and crushing victim.		Proper shoring or sloped trench, along with adequate exits or escapes.	29 CFR 1926.652(c)
10/78 547	06/1365	21	02	Rolling pipes from double joint operation caught worker between girders and pipe picker.		Proper safety training. Written safe work practices. Prevent rolling pipes after the pipe picker has been released.	Section 5(a)(1) OSHA Act
5/75 339	06/3280	17	08	While overhauling and repairing a reactor and a regenerator employees were stricken w/a respiratory type ailment from a chemical.		Report hospitalization of workers w/in 48 hr. to OSHA.	29 CFR 1926.8
1/76 419	06/3280	21 12	02	Worker crushed between the left hand track and counter-weight of a cab sized backhoe. Workers carelessness.	25		No violations.
3/78 40	06/3280 1542	12	05	While descending on a portable ladder an employee untied the top of the ladder in order to move it to a new location & descended the ladder w/out it being secured.	50	Proper tying, blocking or securing of portable ladders.	29 CFR 1926.450(a)(10)
7/74 220	06/3280 1621	21 01	05 01	Laborer fell off loader bucket and was crushed as the hoe ran over him.			No citations.
8/75 377	06/3280 1621	02 12	02	Stabilized shells shifted in a pit but workers were warned to stay out by foreman. Worker's own fault.	42		No violations.

TABLE 6 (Cont'd)

Date Report #	Region/ Area & SIC #	Injury Type	Event Type	Description of Accident	Age of Victim	Comments	Code Violated
8/74 151	06/3280 1611	21	01	Worker crushed when blade being unloaded slipped out of chain & chain whipped out & hit loader.			No violations.
6/76 471	06/3280 1611	21 03	01	Worker killed when he stepped in front of pneumatic roller.	56		No violations.
5/78 623	06/3280	12	05	Worker fell 26 ft. through plywood hatch cover at sewage treatment plant.	61		
12/74 H3103	03/0010	06	01	4x4x16' timber fell from 7th floor during stripping operation. Worker had been warned to stay away from area.			No violations.
1/76 S2650	03/0010	12	05	Accident due to the tipping over of the crane which was supporting the elevator shaft containing the workers.		Boom of crane should not be over-extended.	Law 91-596, Sec. 5A1 Violation Type 5
4/75 B9754	03/0010	06	05	Serious violation cited - man working on 6 ft. high scaffold with no railings positioned adjacent to 8x8' floor opening.		Railings around elevated openings required.	29 CFR 1926.451(a)(4) Cited on a follow-up.
5/76 H3103	03/0010	06	05	Worker killed when scaffold, which he had improperly erected, collapsed. (Not nailed completely)		Accurate and complete scaffold construction.	No citation.

CHAPTER III

CONCLUSIONS

A. Introduction

In Chapter II, Analysis, five significant problem areas related to occupational injuries in the General Building and Heavy Construction Industries were introduced. This chapter presents an expanded discussion of the related causal factors and indicates recommended solutions.

These five problem areas were highlighted in the 261 accident/injury case records reviewed during the field investigation effort. Specifically, they are reflected in the cases reviewed according to the following:

Education and Training	- 53%
Protective Headgear (Hard Hats)	- 46%
Medical Screening	- 42%
Scaffolding	- 41%
Safety Nets	- 40%

B. Inadequate Directed Supervision and Training

As noted in the discussion of causal factors underlying the occurrence of the accident/injury cases reviewed during Phase III of this study, there was a singular lack of development and maintenance of the awareness of danger involved in tasks being performed. This lack of awareness is evidenced by the following:

- Workers did not appear to have full appreciation of the dangers inherent in the tasks they were asked to perform.
- Workers were not provided adequate guidance, in an on-going basis, in the avoidance of the dangerous elements of those tasks.

It was observed during the Phase III field investigation effort that nearly 40 percent of the cases reviewed did not involve any violation of existing standards or regulations (according to the cognizant OSHA investigators). However, in over 50 percent of these "no violation" cases a fatality resulted.

Case file records indicated notations such as "worker's carelessness," "warned by foremen," "no fault found," etc. Apparently, based on the fatality occurrences during "no violation" incidents, a simple warning to a worker is not an adequate preventive measure. A notation of "worker's carelessness" indicates an apparent lack of on-going training or supervision relative to the special hazards of the workplace.

As specified in the field investigation effort and causal factor determination, supervision of activities of workers exposed to a special hazard of the workplace is a specific responsibility of management. Direction of such supervision towards the preclusion of events which could endanger the worker is a specific intent of the standards. It is obvious that this intent is not being met. Trench cave-ins, falls through scaffolding, inappropriate use of equipment (even when exempted under "grandfather" clauses), lack of guidance in the use of equipment near other hazards - such as the contact between a crane and a source of electrical energy, lack of coordination between operations and utilities which leads to such statements as, "I thought that 7200 Amp power source was turned off - I'm sorry he got fried" do not indicate that the requisite directed supervision and/or management was being exercised. Even more frightening is the apparent lack of accountability at the supervisory level. The enacting of laws and standards which hold the company liable and responsible do nothing toward encouraging the delegation of that responsibility to the supervisory level - the one place where preventive action should and must occur.

Finally, on-going, continuous education of workers as to the special hazards of the workplace and continuous supervision of workers to ensure that constant compliance is maintained, should be specified requirements.

C. Inadequate Protective Headgear (Hard Hats)

The in-depth investigations of cases have shown that the required use of personal protection equipment in the form of protective headgear may reduce the incidence of certain types of injuries and/or their severity, but in certain cases fail to accomplish either. The hard hats are not strong enough to absorb impact, i.e., they split or collapse. They do not protect the neck and shoulder areas adequately and may even be accomplishing nothing more than transferring the force of the impact to these areas. The hard hats are not designed to withstand strong lateral or crushing actions.

None of the allegations in the preceding paragraph are 100% accurate because of the divergency of types of personal head protective devices available on the market. However, this fact may be compounding the problems encountered. To fully appreciate this phenomenon, it is necessary to review the current specifications for such equipment.

Generally speaking, hard hat specifications all derive from either ANSI Z89.1 or from ANSI Z89.2, the former dated 1969 and the latter 1971. The industries providing the equipment, through research and manufacturing advances, have managed to far exceed these requirements. However, there are still three basic, and different, lines of products on the market: those designed to protect against (deflect) an impact directed vertically downward; those designed to protect against (deflect) an impact from one direction in the lateral plane; and those designed to protect against high voltages and/or burns. No single product appears to provide adequate protection in all three categories while avoiding the weight and cumbersome-ness which lead workers to shun their use wherever supervision is inadequate or lacking. Protection against multi-directional forces such as

crushing between two objects is yet to be fully achieved, and there appears to be a tendency to sacrifice energy-absorbing capabilities in exchange for lighter weight and freedom of movement. Helmets designed for use to protect against small falling objects are common, with the result that helmets split or puncture. The same result is seen when lateral forces converge which exceed the level of capability intended for the type of hard hat in use. Further, where the helmet is designed to withstand the impact force without rupturing, the force is transmitted directly to the neck and shoulder area of the worker involved, leading to serious injuries or death due to extreme stresses on the cervical vertebrae, particularly those impacting on the odontoid process.

It should be noted, also, that the protection afforded by such equipment is reduced when the individual worker is in any position other than strictly vertical.

In a review of the specifications for hard hats, and a cursory review of the "crash helmet" requirements, it would seem that the "crash helmet" design with the higher degree of head protection and helmet restraint provides better protection. In our review of accidents there were a significant number of injuries caused by either puncture, crushing, or the hard hats being knocked from the worker's head.

The pattern identified, then, is one wherein the primary preventive actions (such as the preclusion of falling objects) break down and place strains on the protective devices which are beyond (or outside of) their designed capacities for function.

D. Inadequate Medical Screening

While the significance of the personal protective equipment requirement cited above is of most importance as it delineates constructive improvement for personal protection equipment, the results of our statistical review also indicate a predominance of (or lack of) data pertaining to the need for medical examinations.

This appears to be true in those cases which involved individuals "prone" to myocardial infarcts (MI), i.e., individuals with a prior history of heart attacks or those in the age brackets where such incidents are most common.

Internal injuries and/or shock contribute stress to the cardiovascular and central nervous systems. Since the most frequent types of injuries observed were those which lead to internal injuries and/or shock, it is not surprising to find a rather high frequency of MI's in both underlying causes of death and in prior medical histories of involved workers. Specifically, a preponderance of the older workers (50 years and up) showed either a history of MI or MI listed as a contributory cause of death.

Based on these observations, consideration should be given to a mandatory medical examination requirement for all employees having a previous coronary condition, employees returning to work following any type of cardiac medical problems and all employees over 50 years of age.

E. Scaffolding - Inadequate Restraint

Existing standards address the problems related to floor openings and open sides of scaffolding construction by specifying railings, toeboards, hole covering and, where materials may be stacked higher than toeboards, complete side coverage. However, these do not provide adequate protection against the (not so unusual) movement of objects in a lateral direction above the toeboard height which are due to other than stacking or piling of construction materials. Specifically, both humans and other objects of widely varying sizes and weights slip through the railing openings.

Current regulations provide for (require) screen (consisting of No. 18 gauge U.S. Standard wire $\frac{1}{2}$ -inch mesh, or equivalent) between the toeboard and the guardrail for all scaffolds where persons are required to work or pass under the scaffold. Conversely, for scaffolds constructed where persons are not required to work or pass under, protective side screening is not a requirement. This latter situation does not preclude, however, that persons will slip or fall through the railing openings or that an uninstructed worker(s) will pass under the scaffold to become a "target" for falling objects (things or people). The use of closeweave netting or other like material should be investigated for the purpose of deterring an individual, equipment and materials from falling from all scaffolds, regardless of restricted passage below. The use of closeweave netting should be made a part of the railing specifications. The use of such protective netting should also be required with all scaffolding and whenever overhead work is being carried on.

F. Safety Nets

Referring to the California data reviewed, analyzed and reported during Phase IV of this study, it is noted that SIC 15 accident types "Struck By or Against" were the cause of approximately one-third of the accidents in the California reported data. This corresponds with the fatality report for other areas studied which showed that "Struck By" was the causal factor for over 70 percent of the fatalities. Further, "Falls or Slips" was the second most prevalent accident type with 29 percent and 26 percent for other areas studied and California, respectively.

For the SIC 16 industries, the main causes which were comparable (other areas versus California) were "Struck By or Against," "Falls or Slips" and "Caught In or Between."

Major differences in the nature of injury were that the area studies showed "Crushing" (Severe Internal Injuries) to be the most prevalent cause of death followed by "Fractures," "Electric Shock," and "Asphyxiation." In the California accident study, however, "Crushing" injuries were a result of one percent of the accidents with "Strains," "Sprains," "Dislocations," "Cuts and Lacerations," and "Punctures" comprising approximately 56 percent of the accidents. These injury types were comparable for both SIC 15 and 16. Again the major difference relates to the severity of the accident. With only accidents studied in the California data, one would not expect the injuries of "Strains and Sprains" and "Cuts and Lacerations" to result in fatalities.

In comparing the more stringent California OSHA Code - Division of Industrial Safety, Construction Safety Orders, Title 8 (Register 75, No. 21 - 5-14-75) Section 170.55, Paragraph 1671:

1671. Safety Nets. (a) Where the elevation is 25 feet or more above the ground, water surface, or continuous floor level below, and when the use of safety belts and lifelines or more conventional types of protection are clearly impractical, the exterior and/or interior perimeter of the structure shall be provided with an approved-type safety net extending at least 8 feet horizontally from such perimeter and being positioned at a distance not to exceed 10* feet vertically below where such hazards exist, or equivalent protection provided. Nets shall be hung with sufficient clearance to prevent user's contact with the surfaces or structures below. Such clearances shall be determined by impact load testing.

Exception: See Section 1710(d), (e) and (f) for flooring requirements and nets for steel erection in tiered building and structures.

(b) Only one level of nets shall be required for bridge construction.

(c) The mesh size of nets shall not exceed 6 inches by 6 inches. All new nets shall meet accepted performance standards of 17,500 foot-pounds minimum impact resistance as determined and certified by the manufacturers, and shall bear a label of proof test. Edge ropes shall provide a minimum breaking strength of 5,000 pounds.

(d) Forged steel safety hooks or shackles shall be used to fasten the net to its supports.

(e) Connections between net panels shall develop the full strength of the net.

It is our conclusion that the vertical distance of 10 feet specified in the California Code appears to have caused a significant reduction in both the frequency and accident rates involving this segment of the construction industry*. Thus, consideration should be given to changing the vertical distance between the hazardous work area and the required safety net to 10 feet instead of the 25 feet currently specified.

G. Summary

Five significant problem areas related to injury in the SIC 15 and 16 industries have been discussed. Based on the review of actual accident/injury case records, causal factors were determined and appropriate corrective measures addressed.

* 29 CFR 1926.105(c)(1) specifies 25 feet for this vertical distance.

Chapter IV, Recommendations, provides suggestions or recommendations for action programs which may be instrumental in reducing the injury and severity rates in the General Building and Heavy Construction Industries, SIC 15 and 16.

CHAPTER IV

RECOMMENDATIONS

A. Introduction

In Chapter II, Analysis, and Chapter III, Conclusions, five significant problem areas were identified and discussed. Based on the data available for review these five areas were analyzed and recommendations (action programs) proposed. These recommendations are based on the analysis and conclusions reached during this study to identify significant hazards and recommend solutions to reduce the injury and severity rates in the General Building and Heavy Construction Industries, SIC 15 and 16.

B. Recommendations

The recommendations for new or revised regulations and/or standards promulgation, which are based on this study of the occupational injuries in the SIC 15 and 16 industries, fall into the following five categories:

- Education and Training
- Protective Headgear (Hard Hats)
- Medical Screening
- Scaffolding
- Safety Nets

The recommendations for each of these five categories are presented in Figure 3.

Figure 3

Recommended Solutions for the Reduction of Injury and Severity
Rates in the SIC 15 and 16 Industries

CATEGORY	RECOMMENDATIONS
Education and Training	Investigate a requirement for an on-going educational program for both workers and supervisors concerning specific hazards of the workplace.
Protective Headgear (Hard Hats)	Consideration should be given to the development of a relatively lightweight hard hat that will provide increased worker protection against the following three common hazards: • Vertically directed impacts • Laterally directed impacts • High voltage and/or burns Consideration should also be given to a requirement for better and/or increased supervision to enforce the use of hard hats in hazardous work situations.
Medical Screening	Consideration should be given to a requirement for mandatory medical examinations for all employees having any previous coronary history, employees returning to work following any type of cardiac medical problem and all employees over 50 years of age.
Scaffolding	Investigate the use of closeweave netting or other like material between the toeboard and handrail for all scaffolds for the purpose of deterring an individual, equipment and materials from falling. In addition to the situations currently covered in 29 CFR 1926.451(a)(6), this would increase worker protection for those situations where netting is not currently required.

Figure 3 (cont)

CATEGORY	RECOMMENDATIONS
Safety Nets	Consider a change in the maximum vertical distance between the hazardous work area and the required safety net to 10 feet instead of the 25 feet currently specified in 29 CFR 1926.105(c)(1).

APPENDIX A

The following matrix indicates, for each of the six 18(b) states which have enacted standards different from the Federal standards cited in 29 CFR 1926, where these differences occur. The appearance of a code number 1, 2 or 3 in the matrix indicates that the State identified by that particular column has enacted a standard which differs from the Federal standard identified in the column entitled Federal Regulation. Thus, if the state has enacted a new or "more effective" standard, a code was entered as follows:

Code 1

Any change which was an additional requirement over and above the Federal regulation, i.e., any State regulation for which there was no corresponding Federal regulation;

Code 2

Any change which altered the effectiveness of a Federal regulation and made the regulation, in the State's opinion, "more effective" or "more restrictive" than the corresponding Federal regulation.

Code 3

Any change which cited a source outside of the submitted State materials, and the source was not readily available for comparison. If the source was available, the comparison was made and placed into the proper category of either code 1 or 2.

Where a code 3 appears in the matrix, a Footnote Reference Code has been entered in the first column to identify the appropriate footnote which cites an outside source. These referenced footnotes are presented at the end of the matrix.

REF.
CODE

FEDERAL REGULATION

ALASKA CALIFORNIA HAWAII MICHIGAN OREGON WASHINGTON

1926	<u>Subpart A</u>	Safety and Health Regulation for Construction General					
1926.1		Purpose and Scope					
1926.2		Variances from Safety and Health Standards					
1926.3		Inspections - Right of Entry					
1926.4		Rules of Practice for Administration Adjudications Enforcement of Safety and Health Standards					
1926.5							
1926.6							
1926.7							
1926.8							
1926.9	<u>Subpart B</u>	General Interpretation					
1926.10		Scope of Support					
1926.11		Coverage under Section 103 of the Act-Distinguished					
1926.12		Reorganization Plan No. 14 of 1950					
1926.13		Interpretation of Statutory Terms					
1926.14		Federal Contract for "Mixed" Types of Performance					
1926.15		Relationship to the Service Contract Act Walsh-Healy Public Contracts Act					

REF.
CODE

FEDERAL REGULATION

ALASKA CALIFORNIA HAWAII MICHIGAN OREGON WASHINGTON

REF. CODE	FEDERAL REGULATION	ALASKA	CALIFORNIA	HAWAII	MICHIGAN	OREGON	WASHINGTON
	1926.16 Rules of Construction						
	1926.17						
	1926.18						
	1926.19						
	1926.20(a) Subpart C - General Safety and Health Provisions					2	
1	1926.20(b) (1)	3		2		2	
1	1926.20(b) (2)	3		2			
1	1926.20(b) (3)		2			2	
	1926.20(b) (4)						
	1926.21(a) Safety Training and Education			2	1		
	1926.21(b)		2	2		1	
	1926.21(b) (3)		2				
	1926.21(b) (5)			2		2	
	1926.21(b) (6)					2	
	1926.22 Recording and Reporting of Injuries (Reserved)						
	1926.23 First Aid and Medical Attention						
	1926.24 Fire Protection and Prevention						
	1926.25(a) Housekeeping			2			
	1926.25(b)			2			
	1926.25(c)			2			
	1926.26 Illumination						2
	1926.27 Sanitation			2			
	1926.28(a) Personal Protective Equipment		2	2			

REF. CODE	FEDERAL REGULATION	ALASKA	CALIFORNIA	HAWAII	MICHIGAN	OREGON	WASHINGTON
	1926.28 (b)		2				
	1926.29 (a)			2			
	1926.29 (b)			2			
	1926.29 (c)			2			
2	1926.30 (a)				3		
	Shipbuilding and Ship Repairing						
2	1926.30 (b)		2		3		
2	1926.31 (a)			2	3		
2	1926.31 (b)			2	3		
	1926.32 (a)					2	
	Definitions						
	1926.32 (b)						
	1926.32 (c)						
	1926.32 (d)		2				
	1926.32 (e)						
	1926.32 (f)		2				
	1926.32 (g)		2				
	1926.32 (h)						
	1926.32 (i)		2			2	
1	1926.32 (j)	3				2	
1	1926.32 (k)	3					
1	1926.32 (l)	3					
1	1926.32 (m)	3					
	1926.32 (n)						
	1926.32 (o)						
	1926.32 (p)						
	1926.32 (q)						
	1926.32 (r)					2	

REF.
CODE

FEDERAL REGULATION

ALASKA CALIFORNIA HAWAII MICHIGAN OREGON WASHINGTON

REF. CODE	FEDERAL REGULATION	ALASKA	CALIFORNIA	HAWAII	MICHIGAN	OREGON	WASHINGTON
	1926.50 Subpart D Occupational Health and Environmental Controls						
	1926.50(a) Medical Services and First Aid		2			1	
	1926.50(b)		2			2	
	1926.50(c)	1	2	2			1
1	1926.50(d) (1)	3	2	2			1
	1926.50(d) (2)		2				
	1926.50(e)	2	1	2		2	
	1926.50(e)	2					
1	1926.50(f)	3	1	2		2	
	1926.51(a) Sanitation					2	1
	1926.51(b)	2		2		2	
	1926.51(c)	2				2	1
	1926.51(c) (3)					1	
	1926.51(c) (4)	2	2				
	1926.51(d)		2				
	1926.51(e)		2			1	
	1926.51(f)		2				
	Occupational Noise Exposure		2	2		2	1
	1926.52(a)	2	2			2	1
	1926.52(b)		2			2	
	1926.52(c)		2			2	1
	1926.52(d) (1)					2	
	1926.52(d) (2)	2	2			1	
	1926.52(e)	2	2				
	1926.52(f)	2	2				
	1926.53(a) Ionizing Radiation						

REF.
CODE

FEDERAL REGULATION	ALASKA	CALIFORNIA	HAWAII	MICHIGAN	OREGON	WASHINGTON
1926.53(b)					1	
1926.54(a)						
1926.54(b)						
1926.54(c)						
1926.54(d)						
1926.54(e)						
1926.54(f)						
1926.54(g)	2					
1926.54(h)						
1926.54(i)						
1926.54(j)						
1926.54(k)	2					
1926.54(l)						
1926.55(a)					2	
1926.55(b)	2					
1926.55(c)	2	2				
1926.56(a)	2	2	2		2	
1926.57(a)	2		2			
1926.57(b)	2				1	
1926.57(c)	2				1	
1926.57(d)					2	
1926.57(e)	1					1
1926.100 Subpart E Personal Protective Life Saving Equipment						

REF.
CODE

FEDERAL REGULATION		ALASKA	CALIFORNIA	HAWAII	MICHIGAN	OREGON	WASHINGTON
1926.106(a)	Working Over or Near Water		2			2	1
1926.106(b)			2			1	
1926.106(c)			2			2	
1926.106(d)			2			2	
1926.107(a)	Definitions Applicable to This Part					1	
1926.107(b)							
1926.107(c)							
1926.107(d)							
1926.107(e)							
1926.107(f)							
1926.150 Subpart F	Fire Protection and Prevention				2	1	
1926.150	Fire Protection					1	
1926.150(a) (1)		2	2	2			
1926.150(a) (2)				2			
1926.150(a) (3)				2			
1926.150(b)			2				1
1926.150(c)			2				
1926.150(d)			2		2		
1926.150(e)			2				
1926.150(f)			2				
1926.151(a)	Fire Prevention						1
1926.151(b)							
1926.151(c)							2
1926.151(c)							
1926.152	Flammable and Combustible Liquids						

REF. CODE	FEDERAL REGULATION	ALASKA	CALIFORNIA	HAWAII	MICHIGAN	OREGON	WASHINGTON
5	1926.153(h) (7)		2				
	1926.153(h) (8-17)		2				
	1926.153(h) (18)						
	1926.153(h) (18)	2	1				
	1926.153(i)		2				
	1926.153(j)		2				
	1926.153(k)		2				
	1926.153(k) (2)						1
	1926.153(l)		2				
	1926.154(a)						
	1926.154(b)						
	1926.154(c)						
	1926.154(d)						2
	1926.154(e)						
	1926.155(a)						1
	1926.155(b)						
	1926.155(c)						
	1926.155(d)						
	1926.155(e)						
	1926.155(f)						3
	1926.155(g)						
	1926.155(h)						
	1926.155(i)						
	1926.155(j)						
	1926.155(k)						
	1926.155(l)						
	Temporary Heating Devices						
	Definitions Applicable to This Subpart						

REF. CODE	FEDERAL REGULATION	ALASKA	CALIFORNIA	HAWAII	MICHIGAN	OREGON	WASHINGTON
	1926.152 (b)	1					
	1926.152 (b) (4) (v)	1					
	1926.152 (b) (4) (vii)						
4	1926.152 (c)						3
	1926.152 (c) (6)						
4	1926.152 (c) (7)						3
	1926.152 (d)						
4	1926.152 (d) (3)			2			3
	1926.152 (e)						
	1926.152 (f)						
	1926.152 (g)						
4	1926.152 (g) (2)						3
	1926.153 (a)		2				
	Liquified Petroleum Gas (LP-Gas)						
	1926.153 (a) (2)		2				
	1926.153 (b)		2				
	1926.153 (c)		2				
	1926.153 (d)						
	1926.153 (e)		2				
	1926.153 (f)						
	1926.153 (g)		2				
	1926.153 (h)		2				
	1926.153 (h) (1)	1	2				
	1926.153 (h) (2)	1	2				
	1926.153 (h) (3)		2				
	1926.153 (h) (5)		2				
	1926.153 (h) (6)		2				

REF. CODE	FEDERAL REGULATION	ALASKA	CALIFORNIA	HAWAII	MICHIGAN	OREGON	WASHINGTON
6	1926.155(m)						
	1926.200 Subpart G Signs, Signals and Barricades				3	1	
	1926.200(a) Accident Prevention Signs and Tags						
	1926.200(b)						
	1926.200(c)						
	1926.200(d)						2
	1926.200(e)						
	1926.200(f)						
	1926.200(g) (2)	2					
	1926.200(h)						
	1926.200(i)					1	
	1926.201(a) Signaling						
	1926.201(a) (3)						
	1926.201(a) (4)					2	
	1926.201(b)					1	
	1926.202 Barricades						
	1926.203 Definitions Applicable to This Subpart						
	1926.250 Subpart H Materials Handling, Storage, Use and Disposal					1	1
	1926.250(a) General Requirements for Storage				1		1
	1926.250(a) (4)						
	1926.250(b)						
	1926.250(b) (2)	2					1
	1926.250(b) (6)						1

REF. CODE	FEDERAL REGULATION	ALASKA	CALIFORNIA	HAWAII	MICHIGAN	OREGON	WASHINGTON
	1926.250(b) (7)						1
	1926.250(b) (8)						1
	1926.250(b) (9)						1
	1926.250(b) (9)	1					
	1926.251(a) Rigging Equipment for Material Handling						
	1926.251(b) (1)		2				
	1926.251(b) (4)		2				
	1926.251(b) (5)		2				
	1926.251(c) (5)						
	1926.251(d) (2) (V)						
	1926.251(e)						
	1926.251(f)						
	1926.252(a) Disposal of Waste Materials						2
	1926.252(b)						
	1926.252(c)						
	1926.252(d)						
	1926.252(e)					1	
	1926.300 Subpart I Tools, Hand and Power General Requirements					1	
	1926.300(a)					1	
	1926.300(b)		2			2	
	1926.300(c)	2	2				2
	1926.300(d)	2				2	
	1926.300(d) (2)	2					
	1926.300(d) (3)	2	2			2	2
	1926.300(d) (5)	2				2	2

REF. CODE	FEDERAL REGULATION	ALASKA	CALIFORNIA	HAWAII	MICHIGAN	OREGON	WASHINGTON
	1926.301(a) Handtools					2	1
	1926.301(b)						
	1926.301(c)						
	1926.301(d)					2	
	1926.302(a) (1) Power Operated Hand Tools						
	1926.302(b)	2	2				
	1926.302(b) (2)		2				
	1926.302(b) (3)						2
	1926.302(b) (4)		2				
	1926.302(b) (9)	2					
	1926.302(c) (1)						
	1926.302(c) (2)						
	1926.302(d) (1)						
	1926.302(d) (1)(2)		2				
7	1926.302(e) (1)	3				1	1
7	1926.302(e) (2)	3					
7	1926.302(e) (12)	3	2				
	1926.303(a) Abrasive Wheels and Tools		2				
	1926.303(b)	2	2				
	1926.303(c) (3)	2	2				
	1926.303(c) (3) (I)						
	1926.303(c) (3) (VI)	2					
	1926.303(c) (3) (VIII)		2				
	1926.303(c) (4)	2					

REF. CODE	FEDERAL REGULATION	ALASKA	CALIFORNIA	HAWAII	MICHIGAN	OREGON	WASHINGTON
8	1926.303(c)(4)	2				2	
	1926.303(c)(6)		2				
	1926.303(d)		2				2
	1926.304(a)		1				
	1926.304(b)		3				
	1926.304(c)						
	1926.304(d)					2	
	1926.304(e)		2				3
8	1926.304(f)		3				1
2	1926.304(f)						
	1926.305					1	
	Jacks, Lever and Ratchet, Screw and Hydraulic						
	1926.305(b)						1
	1926.305(c)						
	1926.350 Subpart J Welding and Cutting					1	
9	1926.350(a)	3	2				
	1926.350(b)						
	1926.350(c)						
9	1926.350(d)	3				2	
	1926.350(d)						
	1926.350(e)						
	1926.350(e)(5)		2			2	
	1926.350(f)						
	1926.350(g)						
	1926.350(h)						
	1926.350(i)		2				

REF. CODE	FEDERAL REGULATION	ALASKA	CALIFORNIA	HAWAII	MICHIGAN	OREGON	WASHINGTON
9	1926.350(j)						
	1926.351(a)						
	1926.351(b)						
	1926.351(c)					2	
	1926.351(d)	3				2	
9	1926.351(e)	3		2			
	1926.352(a)			2			
	1926.352(b)			2			
	1926.352(c)						
	1926.352(d)						
	1926.352(e)						
	1926.352(f)						
	1926.352(g)						
	1926.352(h)						
	1926.352(i)						
	1926.352(j)						
	1926.353(a)		2				
	1926.353(a)(1)						
	1926.353(a)(2)		2				
	1926.353(a)(3)		2				
	1926.353(b)	2	2				
	1926.353(b)(2)	2					
	1926.353(c)	2					
	1926.353(c)(2)	2					
	1926.353(c)(3)	2					

REF. CODE	FEDERAL REGULATION	ALASKA	CALIFORNIA	HAWAII	MICHIGAN	OREGON	WASHINGTON
	1926.353(d)	2	2				
	1926.353(d) (1) (ii)	2					
	1926.353(d) (1) (iv)	2	2			2	
	1926.353(e)	2				2	
	1926.354(a)		2				
	Welding, Cutting, and Heating in Way of Preserva- tives, Coatings		2				
	1926.354(b)		2				
	1926.354(c)	2	2				
	1926.354(d)		2				
	1926.354(d)	1				1	
	1926.400 Subpart K Electrical						
	1926.400(a)	2	2	2			
	1926.400(b)	2		2			
	1926.400(c)		1	2			2
	1926.400(d)						
	1926.400(e)		2				
	1926.400(f)						
	1926.401(a)			2			
	1926.401(b)			2			
	1926.401(c)						
	1926.401(d)						
	1926.401(d) (4)						
	1926.401(e)						
	1926.401(f)						
	1926.401(g)		2	2			
	1926.401(h)		2				

REF. CODE	FEDERAL REGULATION	ALASKA	CALIFORNIA	HAWAII	MICHIGAN	OREGON	WASHINGTON
10	1926.401(i)					2	
	1926.401(j)		2			2	
	1926.402(a)			2			
	1926.402(a)(11)			2			
	1926.402(b)			2			
	1926.402(c)			2			
	1926.402(d)		3	2		2	
	1926.402(e)	2					
	1926.403(a)					2	
	1926.403(a)(3)		2				2
11	1926.403(a)(4)						
	1926.403(a)(5)						
	1926.403(b)						
	1926.404(a)	2					
	1926.404(a)(4)					2	
	1926.404(b)		2				
	1926.404(c)		2				
	1926.404(c)	1					
	1926.404(d)					1	
	1926.405						
	1926.405(k)		2				
	1926.450(a) Subpart L Ladders and Scaffolding	1				1	3
	1926.450(a)(2)						
	1926.450(a)(3)		2			2	
	1926.450(a)(9)					2	

REF. CODE	FEDERAL REGULATION	ALASKA	CALIFORNIA	HAWAII	MICHIGAN	OREGON	WASHINGTON
	1926.450(a) (10)					2	
	1926.450(a) (11) Ladders					1	1
	1926.450(b)		2			2	
	1926.450(b) (3)	2					
	1926.450(b) (7)					2	
	1926.451 Scaffolding						1
12	1926.451(a)	3				2	
	1926.451(a) (4)	2					2
	1926.451(a) (4)	1					
	1926.451(a) (13)					1	
12	1926.451(a) (18)	3					
	1926.451(a) (20)	2					
	1926.451(b) (2)	1				2	
12	1926.451(b) (6)	3					
	1926.451(b) (7)	2				2	
	1926.451(b) (10)	1					
12	1926.451(b) (12)	3					
12	1926.451(b) (14)	3					
	1926.451(b) (15)					2	
	1926.451(b) (16)	2					
	1926.451(b) (16)	1					
	1926.451(b) (21)	1					
	1926.451(b) (21)	1					
	1926.451(c) (13)	2					
	1926.451(d) (10)	3				2	
12	1926.451(e) (3)	2				2	
	1926.451(e) (10)	2				2	

REF. CODE	FEDERAL REGULATION	ALASKA	CALIFORNIA	HAWAII	MICHIGAN	OREGON	WASHINGTON
12	1926.451(f)	3					
	1926.451(g) (2)	2				2	
	1926.451(g) (5)						
12	1926.451(h)						
	1926.451(h) (3)	3					
	1926.451(h) (6)	3					
12	1926.451(h) (8)						
	1926.451(h) (10)					1	
	1926.451(h) (11)					2	
12	1926.451(h) (13)					1	
	1926.451(h) (15)	2				2	
	1926.451(i)						
12	1926.451(i) (4)	1					2
	1926.451(i) (8)	1					
	1926.451(i) (9)					2	
12	1926.451(i) (10)	1				2	
	1926.451(i) (11)	2					
	1926.451(j)	1					
12	1926.451(j) (9)	2				2	
	1926.451(k)						1
	1926.451(k) (6)	2					
12	1926.451(k) (8)						
	1926.451(k) (9)					2	
	1926.451(l) (4)	2					
12	1926.451(l) (4)	1					
	1926.451(l) (5)					2	2

REF. CODE	FEDERAL REGULATION	ALASKA	CALIFORNIA	HAWAII	MICHIGAN	OREGON	WASHINGTON
	1926.451(m)	2					
	1926.451(m) (5)					2	
	1926.451(m) (6)						
	1926.451(m) (6)	2					
	1926.451(n)						
	1926.451(o)						
	1926.451(o) (7)					2	
	1926.451(p)	2					
	1926.451(q)	2					
	1926.451(q) (4)	2				2	
	1926.451(q) (4)	2					
	1926.451(r)						
	1926.451(r) (5)	2				2	
	1926.451(s)	2					
	1926.451(s)	1					
	1926.451(s) (6)	2					
	1926.451(s) (6)	1					2
	1926.451(t)						
	1926.451(u)						
	1926.451(u) (3)	2				2	
	1926.451(u) (3)	2					
	1926.451(u) (5)					2	
	1926.451(v)						
	1926.451(v) (1)	2					
	1926.451(v) (2)	2					
	1926.451(v) (3)	2					

REF. CODE	FEDERAL REGULATION	ALASKA	CALIFORNIA	HAWAII	MICHIGAN	OREGON	WASHINGTON
	1926.451(w)					2	
	1926.451(w)(1)	2					
	1926.451(w)(6)	2					
	1926.451(x)	2					
	1926.451(x)(6)	1				2	
	1926.451(y)	2					
	1926.451(y)(4)	2					
	1926.451(y)(9)					2	2
	1926.451(y)(11)						1
	1926.451(y)(27)						1
	1926.451(y)(28)						1
	1926.451(y)(29)						1
	1926.451(y)(30)						1
	1926.451(y)(31)						1
	1926.452						
	Definitions Applicable to This Subpart						
	1926.452(b)(10)						2
	1926.452(b)(31)						2
	1926.500 Subpart M Floor and Wall Openings and Stairways						
	1926.500(a)					2	
	Guardrails, Handrails and Covers						
	1926.500(b)					2	
	1926.500(b)(3)						2
	1926.500(b)(4)		2			2	
	1926.500(b)(5)		2				

REF. CODE	FEDERAL REGULATION	ALASKA	CALIFORNIA	HAWAII	MICHIGAN	OREGON	WASHINGTON
13	1926.500 (b) (6)		2				
	1926.500 (b) (7)		2				
	1926.500 (b) (8)		2				
	1926.500 (b) (9)		2				
	1926.500 (c)	2					
	1926.500 (d)	2					
	1926.500 (d)	1				2	
	1926.500 (e)		2				
	1926.500 (f)	1				3	
	1926.500 (f) (I) (i)		2			2	2
	1926.500 (f) (I) (iii)						2
	1926.501 Stairways						
	1926.501 (a)		2				
12	1926.501 (b)	2					
	1926.501 (c)						
	1926.501 (d)						
	1926.501 (e)						
	1926.501 (f)	1					
	1926.501 (g)						
	1926.501 (h)		2				
	1926.501 (i)						
	1926.501 (j)		2			2	
	1926.501 (j)	1					
	1926.501 (k)						
	1926.501 (l)	2	2				
	1926.501 (m)	3	2				

REF. CODE	FEDERAL REGULATION	ALASKA	CALIFORNIA	HAWAII	MICHIGAN	OREGON	WASHINGTON
1926.502	Definitions Applicable to This Subpart						
1926.502(a)		2		2	2		
1926.502(b)							
1926.502(e)		1					
1926.502(g)						2	
1926.550	Subpart N Cranes, Derricks, Hoists, Elevators and Conveyors						
1926.550	Cranes and Derricks						
1926.550(a) (1)			1				2
1926.550(a) (2)							
1926.550(a) (3)			1				
1926.550(a) (4)							
1926.550(a) (5)			2	2		2	2
1926.550(a) (6)			2	2		2	
1926.550(a) (7)			2	2			
1926.550(a) (8)			2	2			
1926.550(a) (9)			2	2		2	1
1926.550(a) (10)		2	2	2		2	
1926.550(a) (11)		2		2			
1926.550(a) (12)		2		2			
1926.550(a) (13)		2	2				
1926.550(a) (14)				2		2	
1926.550(a) (15)			2				
1926.550(a) (16)			2				
1926.550(a) (17)							
1926.550(a) (18)							2
1926.550(b)		1	2				

REF. CODE	FEDERAL REGULATION	ALASKA	CALIFORNIA	HAWAII	MICHIGAN	OREGON	WASHINGTON
	1926.550(c)	1					1
	1926.550(d)	1	2				
	1926.550(e)	2	2				
	1926.550(e)	1					
	1926.550(f)						
	1926.551(a)						
	1926.551(b)		2				
	1926.551(c)						
	1926.551(d)						
	1926.551(e)						
	1926.551(f)		2				
	1926.551(g)		2				
	1926.551(h)						
	1926.551(i)		2				
	1926.551(j)		2				
	1926.551(k)						
	1926.551(l)						
	1926.551(m)					2	
	1926.551(n)						
	1926.551(o)						
	1926.551(p)						
	1926.551(q)		2				
	1926.551(r)						
	1926.551(s)						
	1926.552						
	Material Hoists, Personal Hoists and Elevators						
14	1926.552(a)(2)	2	2		3		

REF. CODE	FEDERAL REGULATION	ALASKA	CALIFORNIA	HAWAII	MICHIGAN	OREGON	WASHINGTON
	1926.552(a) (3)		2			2	
	1926.552(b)		2				1
	1926.552(b) (3) (1)						1
	1926.552(b) (3) (2)						
	1926.552(b) (8)		2				1
	1926.552(c)						
	1926.552(c) (6)		2				
	1926.552(c) (7)		2				
	1926.552(c) (8)						1
	1926.553						
	Base-Mounted Drum Hoists						
	Overhead Hoists						
	Conveyors	2					
	Aerial Lifts						
	1926.556(a) (2)		1				1
	1926.556(b)						
	1926.556(b)		1				1
	1926.600 Subpart O Motor Vehicles, Mechanized Equipment, and Marine Operations						
	Equipment					2	
	1926.600(a) (1)	2	2				1
	1926.600(a) (3)		2			1	
	1926.600(a) (4)	2					
	1926.600(a) (6)	2			1		
	1926.601	1					
	Motor Vehicles					2	
	1926.601(a)	3					1,2
12	1926.601(a) (6)		2				

REF. CODE	FEDERAL REGULATION	ALASKA	CALIFORNIA	HAWAII	MICHIGAN	OREGON	WASHINGTON
12	1926.601(b) (3)					2	
	1926.601(b) (4)					2	
	1926.601(b) (5)						1
	1926.601(b) (8)	2					
	1926.601(b) (9)						
12	1926.601(b) (10)	3					1
	1926.601(b) (14)						
	1926.602	2	2				1
	1926.602(a)						
	1926.602(a) (8)	2	3				1
15	1926.602(a) (10)						
	1926.602(b) (6)	2					
	1926.602(c)	1					
	1926.602(c) (1) (ii)						1
	1926.603						
12	1926.603(a) (1)	3		1			
	1926.603(a) (2)	3		1			
	1926.603(a) (8)						1
	1926.603(b)	3					
	1926.603(c)						1
12	1926.603(c) (6)	2	2				
	1926.604	1					
	1926.604(a) (2)	2	2				
	1926.604(a)						
	1926.604(b)	1					1
	1926.605						

REF. CODE	FEDERAL REGULATION	ALASKA	CALIFORNIA	HAWAII	MICHIGAN	OREGON	WASHINGTON
	1926.605(a)	2					
	1926.605(b) (2)						
	1926.605(c) (4)	2				1	1
	1926.605(d) (1)						
	1926.605(e)						
	1926.606	2					
	Definitions Applicable to This Subpart						
	1926.606(e)					1	1
	1926.650 <u>Subpart P</u> Excavations, Trenching and Shoring						
	1926.650						1
	General Protection Require- ments						
	1926.650(a)						
	1926.650(b)						
	1926.650(c)						
	1926.650(d)						
	1926.650(e)	2				2	2
	1926.650(f)		2				
	1926.650(g)	2					
	1926.650(h)		2			2	2
	1926.650(i)	2				2	2
	1926.650(j)	1					
	1926.651(a)					2	
	Specific Excavation Requirements						
	1926.651(b)						
	1926.651(c)						
	1926.651(d)						
	1926.651(e)						

REF. CODE	FEDERAL REGULATION	ALASKA	CALIFORNIA	HAWAII	MICHIGAN	OREGON	WASHINGTON
	1926.651 (f)					2	
	1926.651 (g)						
	1926.651 (h)						
	1926.651 (i)						
	1926.651 (j)						
	1926.651 (k)						
	1926.651 (l)						1
	1926.651 (m)						
	1926.651 (n)						
	1926.651 (o)						2
	1926.651 (p)						
	1926.651 (q)						
	1926.651 (r)	2					
	1926.651 (s)						
	1926.651 (t)						
	1926.651 (u)					2	2
	1926.651 (v)		2				1
	1926.651 (w)						
	1926.651 (x)		2				
	1926.651 (y)	2	2				1
	1926.651 (z)					2	
	1926.652						1
	1926.652 (a)	2					2
	Specific Trenching Requirements						
	1926.652 (b)	2					1
	1926.652 (c)	2	2			2	2

REF. CODE	FEDERAL REGULATION	ALASKA	CALIFORNIA	HAWAII	MICHIGAN	OREGON	WASHINGTON
1926.652(d)	Diagram Definitions Applicable to This Subpart		2				1
1926.652(e)							2
1926.652(f)							1
1926.652(g)			2				1
1926.652(h)							
1926.652(i)							
1926.652(j)							
1926.652(k)							
1926.652(l)			2				1
1926.652(l)							1
1926.653(a)							
1926.653(b)							
1926.653(c)							
1926.653(d)							
1926.653(e)							1
1926.653(f)		2					
1926.653(g)							
1926.653(h)							
1926.653(i)							1
1926.653(j)							
1926.653(k)							
1926.653(l)							
1926.653(m)							
1926.653(n)							
1926.653(o)							
1926.653(p)							

REF. CODE	FEDERAL REGULATION	ALASKA	CALIFORNIA	HAWAII	MICHIGAN	OREGON	WASHINGTON
	1926.653(p)						
	1926.563(q)						
	1926.653(r)						
	1926.653(r)						
	1926.653(s)	2					
	1926.653(t)	2				1	
	1926.700 Subpart Q Concrete, Concrete Forms, and Shoring						
	General Provisions						
	1926.700(a)		2				
	1926.700(a)		2				2
	1926.700(b)(1)						
	1926.700(b)(2)	2					
12	1926.700(c)	3					
	1926.700(d)					2	1
	1926.700(d)(6)						1
	1926.700(d)(8)						1
	1926.700(e)(1)						1
	1926.700(e)(2)						2
	1926.700(e)	1					1
	Forms and Shoring						
	1926.701(a)(1)		2				
12	1926.701(a)(3)	3					
12	1926.701(a)(4)	3	2				
12	1926.701(b)(7)	3					
	1926.701(c)			2			
	1926.701(d)			2			1
	1926.701	1					
	1926.702(a)			1			
	Definitions Applicable to This Subpart						

REF. CODE	FEDERAL REGULATION	ALASKA	CALIFORNIA	HAWAII	MICHIGAN	OREGON	WASHINGTON
1926.702(b)	1926.750 Subpart R Steel Erection Flooring Requirements Structural Steel Assembly Bolting, Riveting, Fitting- Up, and Plumbing-Up			1			
1926.702(c)				1		2	
1926.702(d)				1			1
1926.702(e)				1			1
1926.750				1			
1926.750(a)(1)				2			
1926.750(a)(2)				2			
1926.750(a)(4)			2				
1926.750(a)(4)			2				
1926.750(b)			2				
1926.750(c)							1
1926.751(a)							
1926.751(b)							
1926.751(c)							
1926.751(d)			2				1
1926.751(e)							
1926.751(f)							
1926.751(g)							
1926.751(h)							
1926.751(i)							1
1926.751(j)							2
1926.751(k)							1
1926.751(l)							
1926.752(a)							
1926.752(b)		3					

REF. CODE	FEDERAL REGULATION	ALASKA	CALIFORNIA	HAWAII	MICHIGAN	OREGON	WASHINGTON
12	1926.752 (c)	3					
12	1926.752 (d) (4)	3					
	1926.752	1					
	1926.800 Subpart S Caissons, Cofferdams Tunnels and shafts, Com- pressed Air						
	1926.800 (a) (3)	2					
	1926.800 (a) (4)	2					
	1926.800 (b) (2)	2				2	1
	1926.800 (c) (1)						
	1926.800 (c) (2)					2	1
	1926.800 (d)	2					
	1926.800 (e)	2					
	1926.800 (e) (1)						
	1926.800 (f)	2					
	1926.800 (g)	2					
	1926.800 (h)						
	1926.800 (i)						
	1926.800 (j)	2					
	1926.800 (k)						
	1926.800 (l)	2					
	1926.801 (a)						
	1926.801 (b)						
	1926.801 (c)						
	1926.801 (d)						
	1926.801 (e)						
	1926.801 (f)	2					
	1926.802 (a)						
	Cofferdams						

REF. CODE	FEDERAL REGULATION	ALASKA	CALIFORNIA	HAWAII	MICHIGAN	OREGON	WASHINGTON
	1926.802(b)	2				2	1
	1926.802(c)						
	1926.802(d)						
	1926.803(a) Compressed Air						
	1926.803(b) (6)	2					
	1926.803(b) (10) (xiv)					2	
	1926.803(c)						
	1926.803(d)						
	1926.803(e)						
	1926.803(f) (1)	2					
	1926.803(g)	2				1	
	1926.803(h)						
	1926.803(h) (9)	2					
	1926.803(i) (2)					2	
	1926.803(i) (3)					2	
	1926.803(j)						
	1926.803(k)					2	
	1926.803(k)	1					
	1926.803(l)						
	1926.803(m)	2					
	1926.804(r) Definitions Applicable to This Subpart					1	
	1926.850 Subpart T Demolition						
	1926.850(a) Preparatory Operations			1			1
	1926.850(b)						
	1926.850(c)						
	1926.850(d)						
	1926.850(e)						

REF. CODE	FEDERAL REGULATION	ALASKA	CALIFORNIA	HAWAII	MICHIGAN	OREGON	WASHINGTON
1926.850 (f)	Stairs, Passageways and Ladders	1				2	2
1926.850 (g)							
1926.850 (h)							
1926.850 (i)							
1926.850 (j)							
1926.850 (k)							
1926.851 (a)							
1926.851 (b)	Chutes			2			
1926.851 (c)							
1926.851 (d)							
1926.851 (e)							
1926.851 (f)							
1926.851 (g)							
1926.852 (a)							
1926.852 (b)	Removal of Material Through Floor Openings Removal of Walls, Masonry Sections and Chimneys	1					
1926.852 (c)							
1926.852 (d)							
1926.852 (e)							
1926.852 (f)							
1926.852 (g)							
1926.853							
1926.854 (a)							
1926.854 (b)							

REF. CODE	FEDERAL REGULATION	ALASKA	CALIFORNIA	HAWAII	MICHIGAN	OREGON	WASHINGTON
1926.854 (c)	Manual Removal of Floors Removal of Walls, Floors, and Material with Equipment Storage			2			
1926.854 (d)				2			
1926.854 (e)				1			
1926.854 (f)							1
1926.855	Removal of Steel Construc- tion						
1926.856			2				
1926.857 (a)							
1926.857 (b)							
1926.857 (c)	Mechanical Demolition						
1926.857 (d)							
1926.858 (a)							
1926.858 (b)		2	2				
1926.858 (c)	Selection Demolition by Explosives		2				
1926.858 (d)			2			2	
1926.859 (a)							
1926.859 (b)							
1926.859 (c)							
1926.859 (d)							
1926.859 (f)			2			2	
1926.859 (g)						2	
1926.859 (h)						2	
1926.860		2					

REF. CODE	FEDERAL REGULATION	ALASKA	CALIFORNIA	HAWAII	MICHIGAN	OREGON	WASHINGTON
1926.860	Subpart U <u>Blasting and the Use of Explosives</u>			1		1	
1926.900 (a)				2			
1926.900 (b)	General Provisions		2				
1926.900 (c)							
1926.900 (d)			2				
1926.900 (e)							
1926.900 (f)							
1926.900 (g)							
1926.900 (h)							
1926.900 (i)							
1926.900 (j)				2			1
1926.900 (k)			2				
1926.900 (l)			2				1
1926.900 (m)							
1926.900 (n)			2				
1926.900 (o)							
1926.900 (p)							
1926.900 (q)		2					2
1926.900 (r)		2	2				2
1926.901 (a)	Blaster Qualifications			2			
1926.901 (b)			2	2			
1926.901 (c)			2	2			
1926.901 (d)			2	2			
1926.901 (e)			2	2			
1926.901 (e)				1			

REF. CODE	FEDERAL REGULATION	ALASKA	CALIFORNIA	HAWAII	MICHIGAN	OREGON	WASHINGTON
1926.902(a)	Surface Transportation of Explosives		2	2			
1926.902(b)		2		2			
1926.902(c)				2			
1926.902(d)			2	2			
1926.902(e)				2			
1926.902(f)				2			
1926.902(g)				2			1
1926.902(h)				2			
1926.902(i)			2	1			
1926.902(j)				1			
1926.902(k)				1			
1926.903(a)							
1926.903(b)	Underground Transportation of Explosives						
1926.903(c)			2				
1926.903(d)							
1926.903(e)			2				1
1926.903(f)			2				
1926.903(g)							
1926.903(h)							
1926.903(i)			2				
1926.903(j)			2				
1926.903(k)							
1926.903(l)							
1926.903(m)							
1926.903(n)							

REF. CODE	FEDERAL REGULATION	ALASKA	CALIFORNIA	HAWAII	MICHIGAN	OREGON	WASHINGTON
1926.903(o)	Storage of Explosives and Blasting Agents		2				
1926.903(p)				2			1
1926.903(q)							
1926.903(r)							
1926.904(a)				2			
1926.904(b)				2			
1926.904(c)	Loading of Explosives or Blasting Agents		2				
1926.904(d)							
1926.904(e)			2				
1926.904(f)				2			1
1926.905			2				
1926.905(a)				2			
1926.905(b)			2				1
1926.905(c)							
1926.905(d)			2				
1926.905(e)				2			1
1926.905(f)			2				
1926.905(g)			1				1
1926.905(h)							
1926.905(i)			1				
1926.905(j)			1				
1926.905(k)			1				1
1926.905(l)				2			
1926.905(m)			1				
1926.905(n)				2			
1926.905(q)		2	1				

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FEDERAL REGULATION	ALASKA	CALIFORNIA	HAWAII	MICHIGAN	OREGON	WASHINGTON
1926.905 (s)	2					
1926.905 (t)		1	2			
1926.906 (a)		2	2			
1926.906 (b)			2			
1926.906 (c)			2			
1926.906 (d)		2	2			
1926.906 (e)		2	2			
1926.906 (f)		2	2			2
1926.906 (g)		2	2			2
1926.906 (h)		2	2			2
1926.906 (i)			2			
1926.906 (j)			2			
1926.906 (k)			2			
1926.906 (l)		2	2			
1926.906 (m)		2	2			
1926.906 (n)		2	2			
1926.906 (o)		2	2			
1926.906 (p)		2	2			
1926.906 (q)		2	2			
1926.906 (r)		2	2			
1926.906 (s)		2	2			
1926.906 (t)		2	2			
1926.907 (a)			2			
1926.907 (b)			2			
1926.907 (c)			2			
1926.907 (e)			2			

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ALASKA CALIFORNIA HAWAII MICHIGAN OREGON WASHINGTON

1926.907(f)						1
1926.907(g)						
1926.907(h)						
1926.907(i)						
1926.907(j)						
1926.907(k)						
1926.907(l)						
1926.907(m)						1
1926.908	Use of Detonating Cord					
1926.909	Firing the Blast					
1926.910	Inspection After Blasting Misfires					
1926.911(a)						
1926.911(b)						
1926.911(c)						
1926.911(d)						2
1926.912	Underwater Blasting					
1926.913(a)	Blasting in Excavation Work Under Compressed Air			2		
1926.913(b)				2		
1926.913(c)				2		
1926.913(d)				2		
1926.913(e)				2		
1926.913(f)				2		
1926.913(g)				2		
1926.914(a)	Definitions Applicable to this Subpart			2		

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ALASKA CALIFORNIA HAWAII MICHIGAN OREGON WASHINGTON

1926.914(b)						1
1926.950 Subpart V Power Transmission and Distribution General Requirements						
1926.950(a)					1	
1926.950(b)						
1926.950(c) (1) (III)		2				
1926.950(c)						2
1926.950(d) (1)					2	
1926.950(d) (1) (c) (vi)					2	
1926.950(d) (2)					2	
1926.950(e)						
1926.950(f)		2			2	
1926.950(g)		2				
1926.950(h)						
1926.950(i)		2				
1926.951(a) Tools and Protective Equipment						
1926.951(b)	2					
1926.951(b) (2)		2				2
1926.951(c)						
1926.951(d)						
1926.951(e)					2	
1926.951(f)	2	2			2	
1926.951(f) (2) (i)					2	
1926.951(f) (3)					2	
1926.951(g)						
1926.951(h)						

REF.
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FEDERAL REGULATION

ALASKA CALIFORNIA HAWAII MICHIGAN OREGON WASHINGTON

1926.951(i)						
1926.952(a)	Mechanical Equipment				2	
1926.952(b)					2	
1926.952(c)					1	2
1926.952(c)(1)						
1926.953(a)	Material Handling					
1926.953(b)						
1926.953(c)						
1926.953(d)		2				
1926.953(e)		2				
1926.953(f)						
1926.953(g)		2				
1926.954(a)	Grounding for Protection of Employees				2	
1926.954(b)						
1926.954(c)						
1926.954(d)						
1926.954(e)						
1926.954(f)						
1926.954(g)						
1926.954(h)						
1926.954(i)						
1926.954(j)						
1926.955(a)	Overhead Lines				2	
1926.955(b)(6)(iii)		2			1	
1926.955(b)(8)		2			1	
1926.955(c)					2	

REF. CODE	FEDERAL REGULATION	ALASKA	CALIFORNIA	HAWAII	MICHIGAN	OREGON	WASHINGTON
	1926.955(d)					2	
	1926.955(e)		2			2	2
	1926.955(e)(8)		2			1	
	1926.955(e)(12)(ii)		2			1	
	1926.955(e)(15)		2			1	
	1926.955(f)		2				
	1926.956(a) Underground Lines		2			2	
	1926.956(b)(1)		2			2	
	1926.956(b)(3)						
	1926.956(c)(3)		2				
	1926.956(e)		2			2	
	1926.956(c)(4)						
	1926.957(a) Construction in Energized Substations						
	1926.957(b)						
	1926.957(c)						
	1926.957(d)						
	1926.957(e)					2	
	1926.958 External Load Helicopters						
	1926.959(b)						2
	1926.959(b)(2)						1
	1926.959(b)(7)(1)						1
	1926.960(e)(e) Definitions Applicable to This Subpart						
	1926.960(s)(s)		2				2
	1926.1000 Subpart W Rollover Protective Structures Overhead Protection						

REF.
CODE

FEDERAL REGULATION		ALASKA	CALIFORNIA	HAWAII	MICHIGAN	OREGON	WASHINGTON
16	1926.1000(a)		2				
	1926.1000(b)		2			2	
	1926.1000(c)		2			1	
	1926.1000(d)		2				
	1926.1000(e)		2				
	1926.1000(f)						
	1926.1001						1
	1926.1001(a)						3
	Minimum Performance Criteria for Tops on Superior Loaders, Dozers, etc.						
	1926.1001(b)	2					
	1926.1002		2				
	Protective Frames for Agriculture and Industry Vehicles in Construction						
	1926.1003	1					
	Overhead Protection for Operators of Agriculture and Industry Tractors						
	1926.1003(b)						
	1926.1003(c)						
	1926.1003(d)						
	1926.1003(e)						
	1926.1003(f)						
	1926.1003(g)	1				1	
	1926.1050 Subpart X Effective Dates	2					
	1926.1051						

MATRIX FOOTNOTE REFERENCE LIST

1. State of Alaska General Safety Code
2. Omitted under State Plan Agreement
3. American National Standards Institute (ANSI) Z88.2 - 1969
4. 1972 Editions of NFPA Standards Documents for Handling of Flammable and Combustible Liquids as Opposed to Federally Specified 1969 editions.
5. 1972 Edition of NFPA 251 - Standard Methods of Fire Tests of Building Construction and Materials as Opposed to Federally Specified 1969 Edition
6. ANSI D6.1 - 1971 means 1975 Edition of the Michigan Manual of Traffic Control Devices
7. As Recommended by ANSI and to Conform to State of Alaska General Safety Code
8. ANSI O1.1 - 1971 as Opposed to Federally Specified 1961 Edition
9. Recommendation of NFPA Volume 2
10. California Public Utilities Commission General Order #95
11. Reference to Requirements in WAC 296 - Chapter 24, General Safety Standards
12. By Recommendation of ANSI
13. US DOL - OSHA Field Information Memorandum 75-18, 6 March 1975
14. ANSI Standards Adopted by Elevator Division under 277 of Public Acts of 1967
15. SAE J 319 November 1969
16. British Columbia Workman's Compensation Boards Accident Prevention Regulations 26.16(3)(a)

Phase I - References

ANSI 01.1-1971.

ANSI 288.2-1969.

ANSI Standard D.6.1.

British Columbia Workman's Compensation Boards Accident Prevention Regulations 26.12(3)(A)

California Public Utilities Commission General Order #95.

Code of Federal Regulations, Title 29, Part 1926, July 1, 1977.

Michigan Elevator Division Reference to 227 of Public Acts of 1967.

NFPA (1972 Issue) - Standards Documents for Handling of Flammable and Combustible Liquids.

NFPA (1972 Issue) - Standard Methods of Fire Testing of Building Construction and Material (NFPA 251-1972)

NFPA Volume 2

Society of Automotive Engineers J 319 November 1969.

State of Alaska General Safety Code.

State Plan Agreement (Michigan)

State Plans filed with OSHA under Section 18(b) of the OSH Act by -

- Alaska
- California
- Hawaii
- Michigan
- Oregon
- Washington

US-DOL-OSHA Field Information Memorandum 75-18, 6 March 1975.

WAC 196 Chapter 24 - Washington General Safety Standards.

Phase II - References

ANSI Z16.2

Census Code Occupation Classification, U.S. Department of Commerce, Bureau of the Census, 1970.

Colorado and North Carolina Supplemental Data System Files, 1974.

Occupational Injuries and Illnesses in the U.S. by Industry, 1972-1976.
U.S. Department of Labor, Bureau of Labor Statistics.

Phase III - References

OSHA Management Information System Field Reporting Manual, January 1977.

Phase IV - References

California Work Injuries, 1972-1974

California Work Injuries and Illnesses, 1975-1976

Occupational Injuries and Illnesses Survey, California, 1972-1976

Phase V - References

ANSI Z89.1, 1969

ANSI Z89.2, 1971

California OSHA Code - Division of Industrial Safety, Construction Safety Orders, Title 8 (Register 75, No 21-5-14-75) Section 170.55, Paragraph 1671.

E. Identify Accidents (Investigated) by OSHA Coverage

1. Purpose

The purpose of this phase was to present the results of the evaluation and identification of each of the accidents investigated during the preceding phase, according to the following categories:

- There was a violation of an applicable OSHA regulation that was instrumental in the occurrence of the accident.
- The accident occurred but no applicable existing OSHA regulation was violated.
- The accident occurred but no OSHA regulation existed that would have related to its occurrence.

2. Scope

This phase of the study included a review of the data collected during the field investigation to identify code violations and, where possible, to categorize the accident cases reviewed. The cases are categorized according to whether an OSHA regulation was violated, no applicable OSHA regulation was cited, or no OSHA regulation existed.

3. Approach

The accident/injury cases identified through an OSHA MIS query and subsequently examined during the field investigation efforts provided informational items required for the review and categorization of these mishaps according to OSHA regulation coverage. In addition, the identification and determination of underlying causal factors provides additional information concerning the accident/injury cases required for this phase of the study.

The following specific items of information pertaining to the accident/injury cases reviewed were further evaluated to assist in the categorization of the mishaps:

- State Where Accident Occurred
- Injury Type
- Accident Type
- Description of Accident
- Age of Victim (if reported)
- Code Violated (if any)
- Description of Circumstances Surrounding Mishap
- Causal Factors

OCCUPATIONAL INJURIES
IN THE
GENERAL BUILDING & HEAVY CONSTRUCTION INDUSTRIES
FINAL REPORT

R-2452

May 1979

Prepared for:

National Institute for Occupational Safety and Health
Contract No. 210-77-0032

PLANNING RESEARCH CORPORATION
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