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PLANNING FOR SAFETY ON THE JOBSITE. SAFETY IN INDUSTRY--CONSTRUCTION INDUSTRY SERIES.

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WORK INJURIES AND THEIR MONETARY LOSSES IN THE CONSTRUCTION INDUSTRY CAN BE EFFECTIVELY PREVENTED ONLY THROUGH AN AGGRESSIVE AND WELL-PLANNED SAFETY EFFORT. THIS BULLETIN DISCUSSES THE "HOW" OF PLANNING FOR SAFETY ON THE JOBSITE. IT WAS PREPARED IN THE DIVISION OF PROGRAMING AND RESEARCH, OFFICE OF OCCUPATIONAL SAFETY. CONTENTS INCLUDE (1) THE ADMINISTRATION AND SUPERVISION OF A SAFETY PROGRAM, (2) LAWS, CODES, AND STANDARDS, (3) SAFETY PROGRAM DEVELOPMENT, (4) PERSONNEL SELECTION, PLACEMENT, AND TRAINING, (5) STANDARD SAFE WORK PROCEDURES, (6) LOCATION OF MEN, MATERIALS, AND EQUIPMENT, (7) MOVEMENT OF SUPPLIES AND EQUIPMENT, (8) STORAGE AND PERSONNEL FACILITIES, (9) WORK AREAS AND SURFACES, (10) MECHANICAL EQUIPMENT AND GUARDING, (11) JOB HOUSEKEEPING AND SANITATION, (12) HANDTOOLS AND POWER TOOLS, (13) FIRE PROTECTION AND CONTROL, (14) OCCUPATIONAL DISEASE PREVENTION, (15) PROTECTIVE MAINTENANCE, (16) ELECTRICAL SAFETY, AND (17) PROTECTION OF THE PUBLIC. THE DOCUMENT SIZE IS 6 BY 9 INCHES. IT IS ALSO AVAILABLE AS GPO L16.3--273 FOR 25 CENTS FROM SUPERINTENDENT OF DOCUMENTS, U.S. GOVERNMENT PRINTING OFFICE, WASHINGTON, D.C. 20402. (PS)

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SAFETY IN INDUSTRY

CONSTRUCTION INDUSTRY SERIES

planning for safety on the jobsite

PREFACE

In the complexities of modern construction, work injuries and their monetary losses can be effectively prevented only through an aggressive and well-planned safety effort. The initial phase of such a program is advance planning, begun well before the work starts. Construction companies with low injury frequency rates devote the necessary effort to this advance planning, organize their programs, and keep them active and meaningful.

Successful construction safety programs may differ considerably in the emphasis placed upon various aspects, but certain basic elements are common to all effective accident prevention. Planning is one such element.

This bulletin discusses the "how" of Planning for Safety on the Jobsite. The specifics are more fully discussed in other bulletins of the Safety in Industry series.

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Planning for Safety on the Jobsite

ADMINISTRATION AND SUPERVISION

Effective administration and supervision of a construction safety program is the key to success. Much depends upon the size of the work force involved, the types of work to be performed, and the type and extent of the safety program to be developed.

Among the decisions to be made are: (1) selection of key personnel to conduct or control the program, (2) assignment of safety duties, and (3) delegation of authority where necessary. Also, policy statements and directives should be written and issued; procedures for processing and using reports and records established; plans for promotion of safe work conditions and safe work methods made; and responsibilities of subcontractors and coordination with them established.

Second to the humanitarian purpose, the financial incentive offers a compelling reason for care in planning administrative and supervisory procedures for a company safety program. Accident prevention can greatly affect bidding considerations, insurance costs, and many other company welfare factors. Five administrative essentials to a successful program are:

1. *Management interest.*—Top management should treat accident prevention as it does other important areas of decision and direction.
2. *Sufficient organization.*—A planned and organized approach should be made to enlist and maintain the combined effort of all personnel in the cause of accident prevention.
3. *Supervisory support.*—The supervisor is the "key man." Not only is his active participation necessary, but journeymen and other workers will contribute more when their supervisor exerts active leadership.
4. *Safety education for personnel.*—Employees should be given as much formal safety training as possible, and

supplementing this, they should be educated every day through continuous promotion of safety. The value of safety knowledge is proportionate to its distribution.

5. *Employee participation.*—The worker's stake in safety is the perfect foundation upon which to develop his awareness, interest, and active participation in the accident prevention effort. His protection is the greatest need around which the program is developed. Therefore, management should encourage the employee to promote safety, assuring him in every possible way that his participation is not only welcome, but earnestly solicited.

The following chart shows in brief details of administrative and supervisory action around which a good construction jobsite safety program may be built.

Administrative	Supervisory
Establish safety policy.	Submit ideas for safer tools, equipment, and processes.
Provide safe environment.	Care for equipment and keep it safe.
Provide competent supervision.	Know value of proper guards; see that they are used.
Delegate responsibilities.	Take pride in using equipment safely.
Provide education and training in safety.	See that safety precautions are observed.
Investigate accidents.	Know hazardous materials, safe handling methods.
Measure safety performance.	"Think safety" to impress it on men.
Maintain records.	Practice safety as example.
Provide continuing support.	Be fair, firm; show no favoritism.
Coordinate with subcontractors.	Study accident occurrences; take corrective action.
Create incentives for participation.	

RESPONSIBILITY OF THE SUPERVISOR

The foreman must be the keyman in every safety program because safety is not something separate and apart from construction work. Safety is an integral and important part of the jobsite

operations, just as are the quality and quantity of each day's building operations. All are the foreman's responsibilities.

As the person in charge, the foreman is responsible for injuries to his men. This should be clearly stated in the "Statement of Policy" issued by management.

SUBCONTRACTING PROBLEMS

A very real problem is the occasional subcontractor who does not require safe practices of his workers, operates unsafe equipment, fails to provide personal-protective equipment, and otherwise ignores accepted accident prevention measures; who does not carry compensation and/or liability insurance; does not comply with codes and regulations; flaunts recognized safety standards; and otherwise defeats the purposes of a general contractor's efforts to maintain a safe jobsite.

To overcome this problem, a "safety clause" should be included in the contract between the prime contractor and subcontractors. There are at least 10 areas which should be covered in the contract:

1. Acquisition of compensation and liability insurance.
2. Maintenance of safe equipment.
3. Safe work practices.
4. Compliance with all applicable laws, codes, ordinances, and regulations.
5. Observance of recognized safety standards, such as those promulgated by the American Standards Association, National Safety Council, etc.
6. The right of the general contractor to approve conditions and practices.
7. Continuing collaboration on safety between prime and subcontractor.
8. Provision, by the subcontractor, of any necessary protective equipment.
9. Planned, and continuing, safety promotion activities by subcontractors.
10. Maintenance of "followup" procedures by the prime contractor to guarantee continuance of acceptable accident prevention measures by the subcontractor.

To promote his own interests, the general contractor must demand proper accident prevention and related action by those to whom he subcontracts.

LAWS, CODES, AND STANDARDS

Laws, codes, regulations, statutes, ordinances, and rules affect construction accident prevention. Statutes and ordinances are laws enacted by a legislative body. Codes and rules are groups of regulations having the force and effect of law, usually promulgated by a governmental agency as authorized by the legislature. Standards are gauges established as a result of common usage, custom, or general consent as being proper or adequate for a given purpose, but which do not have the force of law. Copies of statutes, ordinances, and codes applying to safety on any job can be obtained from State and local labor agencies.

Standards affecting the construction industry have been developed by a number of organizations, such as the American Standards Association, American Society for Testing and Materials, National Fire Protection Association, and others.

Standards promote uniformity in design, physical properties, construction and control measures. They permit preparation of specifications from which known results will be obtained. For instance, standard number 12 copper wire specified for use in a 110-volt circuit is safe for 20 amperes load for up to 50 feet of wire. Standards provide the basis on which to judge or measure the relative safety of devices or equipment. Standards and codes often aid the contractor by indicating for him the best of, perhaps, several methods, items, or ideas.

Some uses for safety standards are:

1. *Specifying* guards for equipment, protective devices, guards for floor openings, ladders, and personal protection.
2. *Determining* work injury experience, lighting requirements.
3. *Inspecting* compressed air machinery, cranes, derricks, hoists, controls for signaling devices.
4. *Establishing* safety rules and work methods for various operations.
5. *Designing* equipment, such as piping, blowers, exhaust systems.
6. *Checking* allowable concentrations of toxic dusts and gases, sanitation, ventilation.

Sources of Standards

National organizations from which one can acquire information regarding standards are:

American Standards Association
10 East 40th Street
New York, N.Y. 10016

Associated General Contractors
1957 E Street NW.
Washington, D.C. 20006

National Constructors Association
1012 14th Street NW.
Washington, D.C. 20005

National Safety Council
425 North Michigan Avenue
Chicago, Ill. 60611

American Insurance Association
85 John Street
New York, N.Y. 10038

American Mutual Insurance Alliance
919 North Michigan Avenue
Chicago, Ill. 60611

National Bureau of Standards
Washington, D.C. 20234

Industrial Hygiene Foundation
4400 Fifth Avenue
Pittsburgh, Pa. 15213

National Fire Protection Association
60 Batterymarch Street
Boston, Mass. 02110

American Society for Testing Materials
1916 Race Street
Philadelphia, Pa. 19103

Underwriters' Laboratories
207 East Ohio Street
Chicago, Ill. 60611

Also, various other trade, industry, union, governmental, and educational organizations.

SAFETY PROGRAM DEVELOPMENT

Since the ultimate responsibility for preventing accidents rests on management, "direction" should come from a high official—the President, Vice President for Personnel, General Manager, or other top official, depending upon the organization of the company. Responsibility should be placed with a person who not only has a genuine interest in safety, but who can and will take the time necessary to effect it.

In larger construction companies, actual administration of the safety program should be a full-time job. The title may be safety director, safety engineer, or safety supervisor. To the workers, he may be simply the "safety man." His duties should be administrative and advisory, with the line management responsible for action.

The safety director should be able to advise the operating officials—project manager, superintendent, foreman—and other heads of operating units or divisions on safety matters of interest or importance to them. Suggestions to supervisors on the prevention of accidents should follow the regular channels used for any matter of company business. In smaller companies, safety administration may be a collateral duty, or performed by a safety committee.

Assessment of Progress

The responsibility of management for the prevention of accidents carries with it the continuing responsibility to assess the progress being made and to bring about improvement where progress is unsatisfactory. To carry out this evaluation, definite lines of communication must be maintained between management and the person actually administering the program.

The size and complexity of the safety program will determine what kinds of reports to management are desirable and how often they should be submitted. Types of reports necessary to record the operation of a modest safety program would include:

Report of accident.
Accident investigation report.
Inspection report.
Performance reports (injury frequency and severity).[1]
Accident cost reports.
Safety committee minutes.

Other bulletins in this series will go into the details of the activities represented by these and other reports.

Worker Participation

Many safety programs fail because the individual worker has not been made to feel that it is *his* program—that he can contribute to it as well as benefit from it. To ensure employee participation, there should be convenient means of communication between management and the men. Mutuality of understanding and respect should be created so that problems can be discussed and decisions made without creating ill will. On a small construction job, this may be no problem. If management (as represented by the "boss") knows each man personally, the ideal condition exists for effective communication. But with widely scattered jobsites employing many men, it is necessary to develop special means for management to make its wishes known and to hear suggestions on safety from the men.

The *safety committee* is one device for developing and promoting this cooperation. A safety committee does not take away the supervisor's responsibility for safety, but it does help him in his constant effort to extend communication to the prevention of accidents.

Types of Safety Committees

1. *Labor-Management Committee.*—Union contracts often contain safety clauses that prescribe joint acceptance of

[1] "Using Injury Statistics," Bull. 255, Bureau of Labor Standards, U.S. Department of Labor.

safety responsibility, and the specific duties of labor and management. Union members of such a committee generally are appointed by their unions.

2. *Management Committee.*—Where there is no union agreement or where the agreement contains no safety clause, the safety committee functions directly under the policies established by management. Management may, and often does, appoint labor members to this committee.

3. *Supervisory Committee.*—Some management safety committees are made up entirely of supervisory personnel. In many cases, this type of committee supplements the activities of a committee which includes workers.

4. *Technical Committee.*—Problems requiring specialized knowledge, engineering revision, controls, or design, or those relating to special processes or operations are often handled by a committee composed of engineers, the safety engineer, the electrical foreman, or other qualified technicians.

5. *Special Committees.*—Committees may be set up for specific activities, such as safety contests, safety celebrations or awards, accident investigations, special safety campaigns, and so on.

What a Safety Committee Is

A safety committee is a group of employees appointed to aid and advise management on matters of worker safety. The committee may be composed of top management and two or three supervisors, or a supervisor and several workers, or any other combination of supervision and workers. It is important that top management be represented and participate in the organization and conduct of committee meetings.

The chairman should be a supervisor and should be chosen for his qualities of leadership, interest in safety, and ability to get results. The safety director may serve as secretary or advisor to the committee.

Through its activities and reports, the safety committee keeps management informed regarding the safety of the worker on the job, the surrounding area, and the equipment.

Safety committees will vary in size and type, but they should be kept as small, yet as representative, as possible in order to expedite prompt action, agreement, and results on safety problems.

What a Safety Committee Does

A successful safety committee helps develop the safety program and takes part in making it operate. Its activities will be determined by the size of the committee and the policies set up by the contractor's management and the group. It is well to provide definite policies at the time the committee is established. They should include some or all of the following:

1. Procedures for handling safety suggestions and recommendations of the committee.

   The success of the safety committee depends to a great extent upon the means provided for complying with or rejecting suggestions and recommendations, and the subsequent followup. A step-by-step procedure for handling recommendations should follow some definite pattern, such as:

   a. Recommendation submitted to committee by worker or committee member.
   b. Recommendation accepted, modified, or rejected by committee.
   c. Accepted or modified recommendations submitted to top management.
   d. Decision reported to originator of recommendation.
   e. Final report to committee on completion of recommendation.

2. Regularly scheduled meetings for the purpose of discussing accident prevention methods, safety promotion, items noted on inspections, injury records, and other pertinent subjects.
3. Regular, periodic inspections of the jobsite for the purpose of discovering accident sources and hazards.
4. Accident investigation for the purpose of recommending means of preventing recurrence.
5. Information to foremen regarding safe work conditions and practices.
6. Recommended changes or additions to protective equipment or devices to eliminate or control hazards.
7. Safe practices or rules developed or revised to comply with current and changing needs.
8. Promotion of safety and first aid training.
9. Sponsored meetings, contests, and other devices for the purposes of developing and maintaining employee interest.
10. In some cases, assistance in developing a safety manual.

Safety Projects

Most successful safety programs are based not only on finding and eliminating the main environmental causes of accidents, but on carrying out special promotional campaigns with the employees to eliminate the personal causes. Such campaigns (fire, electrical, falls, etc.) on a regular schedule can be quite effective and many techniques can be used to stimulate interest in them.

In some situations, special safety projects are set up on a monthly basis, but, owing to the nature of the construction industry, a weekly safety project on many jobs would be even more productive.

Safety Inspections

On the construction job, materials are moved, stockpiles are depleted, waste materials accumulate, and many other changes occur daily or even hourly. Changes in machinery occur as a result of use, wear, or abuse. There are changes in layout, additions of equipment, and so on.

Safety inspections are a means of surveying and appraising the problems of unsafe conditions and work practices which result from these changes. Safety inspections should provide for (1) *detection*—seeking out the unsafe methods and conditions; (2) *analysis*—determining why the unsafe methods or conditions exist; and (3) *correction*—eliminating the unsafe conditions or methods, and finding the reasons for them where possible.

It is most desirable that safety inspections should be made by "qualified personnel" but, on many construction jobsites, "qualified personnel" may not be available. Help in inspecting can be obtained from the State and Federal Government, and from insurance firms, fire departments, and similar sources. Also, management can help develop the inspection abilities of its own staff by providing them with available educational materials on safety and inspections. Formal safety training courses and attendance at safety exhibits and meetings will also help.

Accident Investigation

Accidents which occur on the construction job should be investigated to discover the hazardous conditions and practices which caused them, so that further accidents from similar causes can be prevented. The investigation should take place as soon as possible after the accident. Delays of only a few hours can permit information or items of importance to be removed, destroyed, or forgotten.

A good accident investigation should produce the answers to (1) *how* did the accident happen; (2) *where* did it happen; (3) did an *injury* result and, if so, to whom; (4) *when* did it happen; (5) *why* did it occur; (6) *what* were the materials, machines, equipment, or conditions involved; and (7) *how* can a recurrence be prevented? Any attempt to fix blame should be avoided. If every person involved—foremen, workmen, those investigating—knows that the sole purpose of the investigation is to prevent recurrence and *not* to blame, there will be no incentive to withhold essential information, and the investigation can produce all the facts to aid in further prevention activities.

A hard question to answer is, "Which accidents should be investigated?" All accidents are important regardless of seriousness of any resulting injury, since the "injury result" of any set of accident-producing circumstances is impossible to predict. The recurrence of "minor" accidents which have not received the proper attention and corrective action has resulted many, many times in a serious accident and a serious injury. Possibly the best answer to the question is, "Investigate as many as time and personnel permit."

Promotion of Interest

In approaching this phase of your program activities, it is well to base your planning on the factors that influence people. Some of the more important factors, as they affect accident prevention program participation are:

1. *Fear of personal injury.*—No one wants to be injured, and employees need to be informed of hazards and told how these hazards can result in injury.
2. *Desire for leadership.*—Those with a desire and ability for leadership should be used to guide and to set examples to others in promoting the safety program.
3. *Desire to excel and be outstanding.*—This factor can be used in contests of many kinds so that individuals and groups may prove that they excel in preventing accidents.
4. *Desire for reward.*—Interest can be aroused or maintained by rewarding workers for good safe work practices, extended periods of work without injury, or other safety accomplishments.
5. *Creating a favorable impression.*—Every employee wants approval, and management's appreciation of his efforts is important.
6. *Fear of economic loss.*—Workers should be advised of the economic losses that result from injuries, such as wage

losses, possible loss of future earning power, and the threat of family well-being and security.

7. *Protection of others.*—No one wants to cause injury to a fellow worker, and workers need to be shown that if they cause an accident, or set a poor example, it might result in injury not only to themselves but to others.

A variety of devices may be used to promote the safety interest of your employees. Among the most commonly used are:

1. *Safety meetings.*—A great variety of interest-developing stunts (each with a safety message), talks, movies, demonstrations, and the like, can be used to liven up meetings; they are helpful if properly used. The length, type, size, and other aspects of your meetings will, of course, have to be tailored to the individual needs of your jobsite program.
2. *Safety contests.*—Some of the greatest accomplishments are the results of contests—the progress made by the nonwinners in improving their own safety performance. It is extremely important that contest rules be clear, definite, and fair to all contestants.
3. *Bulletin boards.*—Every construction jobsite, regardless of size, should have one or more safety bulletin boards. It is important that the board be well made, attractive, well finished, and properly maintained. Material should be arranged neatly and outdated material removed promptly. Posters and notices should be changed often. The board should be well illuminated, either by natural or artificial means. Boards should be located where they can be easily seen by all employees.
4. *Publications.*—Company organs are valuable for providing safety material when it is newsy, interesting, and suitably written. Material should be timely and pertinent to conditions of the jobsite. Humorous illustrations should make a "safety point." Photographs of hazardous situations or of persons with safety accomplishments are valuable.
5. *Signs and slogans.*—Include payroll inserts and similar media. These are widely used to promote safety. Properly used, they give an instant message, emphasizing an attitude of readiness to do everything possible to prevent work injuries. They should be simple, brief, self-explanatory, and eye catching.
6. *Suggestion systems.*—Suggestion systems to elicit the workers' ideas for improving work conditions and methods are productive devices. They can be very helpful if

properly used and effectively promoted. The following points are based on successful experiences:

a. Management should really *want* suggestions from its workmen.
b. Every suggestion should be taken seriously, and if it is not usable, an explanation should be made to its originator.
c. Action in each instance should be reasonably prompt, or the reason for any necessary delay explained.
d. Anonymity should be respected, if desired by the maker of the suggestion.
e. Rewards should be in reasonable relation to the value of the suggestion.
f. Management should collaborate with employee organizations in operating the system, and encourage their cooperation.

7. *Awards.*—These may be made on a group or individual basis, or both. There are a great many types of awards and many types of systems for making them, but, obviously, the essential element represented here is that recognition for accomplishment or performance, fairness, good promotion, meaningful awards, and sincerity is the foundation for a fulfilling award program.

8. *External liaison.*—Many contractors (particularly the smaller ones) are unable to effectively promote accident prevention because they have difficulty in getting safety information.

There are many sources of valuable assistance with which the contractor who is sincerely interested in developing a meaningful safety program can maintain liaison. Among these are the following:

National Safety Council
(Construction Section)
425 North Michigan Avenue
Chicago, Ill. 60611

Associated General Contractors
of America
1957 E Street NW.
Washington, D.C. 20006

National Constructors
Association
1012 14th Street NW.
Washington, D.C. 20005

American Standards Association
10 East 40th Street
New York, N.Y. 10016

American Insurance Association
85 John Street
New York, N.Y. 10038

American Mutual Insurance
Alliance
919 N. Michigan Avenue
Chicago, Ill. 60611

National Association of Home Builders
1625 L Street NW.
Washington, D.C. 20036

Office of Occupational Safety
Bureau of Labor Standards
U.S. Department of Labor
Washington, D.C. 20210

Departments of Labor and Industry of the various States

National Bureau of Standards
U.S Department of Commerce
Washington, D.C. 20234

Many trade associations, e.g., American Concrete Institute, American Gas Association, Edison Electric Institute, and others, also publish materials relating to construction safety or provide other kinds of assistance. Most of the union organizations related to the construction industry also provide materials and assistance.

In addition, educational institutions throughout the country have on-campus, extension, and correspondence courses in accident prevention. A complete list of these institutions has been prepared by the American Society of Safety Engineers and is available from them at 5 North Wabash Avenue, Chicago, Ill. 60602.

Contact should also be developed and maintained with local safety councils, fire departments, union organizations, and the many other similar organizations or individuals interested in furthering jobsite accident prevention.

PERSONNEL SELECTION, PLACEMENT, AND TRAINING

For almost every accident in the construction industry, there are two contributing causes—an unsafe condition and an unsafe act. A safe and healthful jobsite will diminish or eliminate the unsafe condition, but unless the unsafe act is prevented, accidents will continue to occur on any construction job, no matter how safe the conditions. Unsafe acts may stem from a number of factors, among which are improper placement of the worker and lack of safety training.

Selection and Placement

Haphazard placement is undoubtedly at the root of a substantial portion of work-connected injuries, particularly where, as in some phases of the construction industry, the potential hazard is high. Every effort should be made to match the qualifications of the man with the demands of the job. Some large construction companies have developed "manning tables" for each job, listing job requirements, such as the amount of lifting necessary, re-

quirements for acuity of hearing, ability to read instructions, and other factors, in addition to the technical skills required. These requirements are then matched against an applicant's qualifications to determine his fitness for the job.

Such elaborate schemes are not usually available but every effort should be made, in even the smallest construction contracting business, to place the man in a job for which he is physically, and by training, qualified to handle. Since no method of preemployment appraisal is completely infallible, all placements should be tentative to the degree that they should be subject to continuing on-the-job appraisal, until the suitability of the person for that particular work is definitely established.

Training

Unsafe work practices may take many forms: using the wrong tool, using a tool incorrectly, failure to use guards or protective equipment, taking unnecssary chances, assuming an awkward position, or failure to practice safe housekeeping, to name but a few. Such unsafe practices suggest a lack of effective safety training and lax supervision which permits them to continue. In establishing or operating a safety program on a construction jobsite, an appraisal of work practices is needed, and training methods should be initiated to correct unsafe practices.

Job safety training is not something apart from job skill training. Perhaps a better name for the "whole" would be job training with safety. And its effectiveness depends on the ability of the trainer—usually the foreman—to teach.

The principles of successful job instruction training might be summarized as follows:

Step I.—Prepare the worker to receive instruction:

a. Put him at ease.
b. Explain the job and find out what he already knows about it.
c. Interest him in learning the job as you want him to.
d. Place him in the correct position.

Step II.—Present the operation:

a. Tell him, show him, illustrate one important step at a time.
b. Stress each key point.
c. Instruct clearly, completely, and patiently, but no more than he can master.

Step III.—Try out his performance:

a. Have him do the job—correct errors.

b. Have him explain each key point to you as he repeats the job.
c. Make sure he understands.
d. Continue until you know he knows.

Step IV.—Followup:

a. Put him on his own. Designate the person to whom he should go for help.
b. Check frequently, encourage questions.
c. Taper off coaching and close followup.

In particularly hazardous construction operations, where a more detailed method of safety training is necessary, job safety analysis may be used.

STANDARD SAFE WORK PROCEDURES

Job analysis methods and techniques have been developed as an essential part of production control for industry in general. They involve the detailed description of each job in terms of duties, tools, working conditions and, particularly, methods, and they are supplemented by a brief description of such personal requirements (where applicable) as health, education, specialized skills, and so on.

Such thorough analysis in planning and control is usually a by-product of quantity production. Only a small part of industry is on a quantity production basis, but the *principles* of analysis, planning, and control can be used in many industries, including construction, where quantity production is apparently not possible. The extent to which it is practical, desirable, or possible to routinize, jobs will vary with conditions. But, relatively few companies have done it to the degree possible.

To establish *standard safe work procedures* for your jobsite requires a study of the hazards connected with each specific job. From this study, the work methods and protection necessary to make the work safe can be developed.

Before beginning a job safety analysis, it is necessary to define the precise limits of the job. Most individual construction jobs can be divided into three sections or segments: (1) preparation (making ready or setting up); (2) operation (the "doing"); and (3) disposal (the transport of either the product created or the materials or waste relating to it). To illustrate: a carpenter's job could involve (1) the functions necessary for him to get ready to build a form; (2) the building of the form; and (3) handling

the completed form sections, the materials involved, or the waste produced by the work.

A separate analysis should be made for each phase of the job, involving only the performance within those limits.

The useful purposes of a job safety analysis include:

1. Discovery and elimination or safeguarding hazardous motions, positions, or actions.
   a. Reaching over moving equipment or objects.
   b. Reaching with hand, foot, or tool beyond range of clear vision.
   c. Moving too rapidly for conditions.
   d. Taking off-balance positions.
   e. Lifting or handling a tool or heavy or awkwardly shaped object with an incorrect posture.
   f. Taking a hazardous position in relation to the work or machine.
   g. Taking a hazardous position in relation to other workmen.
2. Discovery of physical hazards.
   a. Position of fixed objects against which workmen may injure hands, feet, head, etc.
   b. Tools or equipment not fully adequate to, or safest for, the purpose intended.
   c. Faulty layout of "handling" operations likely to yield hand or foot injury or strain from lifting.
3. Determination of the qualifications required for the safe performance of the work, such as physical fitness, motor skills, special abilities, etc.
   a. Ability to do required lifting without strain.
   b. Adequate reflexes and coordination.
   c. Stature suited to the work.
   d. Sufficient hearing, particularly where audible signals are used.
   e. Vision appropriate for the work required, especially where visual signals are used.
   f. Agreeable personality traits for jobs where smooth teamwork is important.
4. Determination of equipment or tools needed for safety.
   a. The safest type of scaffold or ladder for overhead work.
   b. The safest type of tool needed for handwork.
   c. Personal protective equipment required.
   d. Use of power tools or handtools.
   e. Specialized equipment which may be necessary.

5. Establishment of standards requisite for safety.
    a. Application to the job of existing codes, statutes, and ordinances.
    b. Application of existing standards or creation of special standards for the work to be done.

When possible, job safety analysis should be applied to the construction job before the work actually begins. Thus many accidents can be eliminated "before they happen."

LOCATING MEN, MATERIALS, AND EQUIPMENT

This topic can only be approached in general terms in this discussion. However, certain guidelines should be followed.

The location of certain equipment—material hoists, for instance—would be selected for *engineering* reasons. The locations of some other facilities, such as the "superintendent's shack" and repair shops, might be on the basis of *space available.* Location of numerous other categories may be made on a *selective* basis—toilet facilities and storage, for example. Since a safe and healthful place to work is the very foundation of the jobsite safety program, these mechanical, physical, and environmental conditions should be carefully evaluated.

On the construction job, efficient layout of machines, materials, structures, equipment and facilities can minimize the movement of individuals and work-in-process, and, consequently, the likelihood of an accident. The "straight-line" standard should always be applied, but this is often difficult to achieve on a construction job.

When planning the location of facilities and equipment, among the basic factors to be considered are:

1. Relation of one function to another.
2. Space for the performance of the function.
3. Space for materials.
4. Space for moving about.
5. Space for scrap removal.

Easily detected conditions which indicate that these problems have not been adequately met include:

1. Unduly large amounts of work or materials "in process."
2. A glut of materials at certain points; a lack at others.
3. Crossing or intermingling of routes over which materials or work "in process" are being transported.
4. "Traffic jams."

5. Inadequate working space.
6. Inadequate storage space.
7. Badly located key facilities, such as toolrooms.
8. Undue accumulations of waste and scrap.
9. Wasted "travel" by workers to perform duties.
10. Processes not in efficient sequence.
11. Unsafe access.
12. Unsafe maintenance procedures.

MOVEMENT OF SUPPLIES AND EQUIPMENT

The handling of supplies, materials, and equipment is one of the chief sources of injuries in the construction industry. Every type of material and every article handled on the jobsite should be studied and consideration given to the weight involved, the character of the material or article, the means for unloading from vehicles, storing, handling in process, preparing for use, etc. Materials hazards may originate either from the way the materials are handled or from their potentially hazardous nature.

Probably no one phase of modern construction has undergone more radical changes than has materials handling which has become a highly specialized branch of engineering. The construction industry, as we now know it, would be handicapped without the highly mechanized materials-handling equipment now in use. Some of the basic equipment is:

1. Handtrucks, buggies (manual and power), wheelbarrows, skids, rollers, forklifts, and similar equipment for general handling of materials.
2. Cranes, derricks, hoists, and other hoisting apparatus for raising and lowering a load and transporting it horizontally within fixed limits.
3. Power conveyors, chutes, slides, etc.
4. Power shovels, draglines, and other digging and loading devices.

When planning for safety in the movement of supplies and equipment on the jobsite, avoid unnecessary exposures by such methods as:

1. Planning and arranging the operations and methods to eliminate hazardous situations and ensure adequate control at all times.
2. Substitution of mechanical handling for manual handling to the maximum degree possible.
3. Adherence to accepted standards for storage.

4. Careful placement and training of personnel.
5. Adequate and competent supervision.
6. Provision of protective equipment.

Indicators of Bad Handling Methods

Symptoms which indicate a need for improvement in methods include:

1. Confusion and lack of order.
2. Manual handling, when other means would be more efficient.
3. Manual handling of heavy objects.
4. Narrow and crowded travel routes and material storage spaces.
5. Overloaded or carelessly loaded equipment or carriers.
6. Poor maintenance of mechanical handling equipment.

Mechanical Handling Methods

The substitution of mechanical handling is usually done because it is faster and more efficient, but each step in the mechanization of materials handling methods has eliminated or diminished certain hazards. Each of these new developments has also created some new hazards which, if not controlled, could offset the increased safety of the mechanical methods.

Safety Through Design

When purchasing cranes, derricks, and hoists, the contractor should specify that they comply with the requirements of the American Standard Safety Code for Cranes, Derricks, and Hoists, B30.2. When such equipment is fabricated by the user, the requirements of the code should be followed.

Safety in Operating, Handling the Load, and Signaling

The crane operator is the keyman in safety in his operation, and rules to govern his conduct should be established and observed. Bulletin 219 of this Bureau's Safety in Industry series entitled "Mechanical Handling of Materials" contains detailed suggestions on safe methods for operating, handling the load, and signaling. Single copies are available from the Bureau of Labor Standards, U.S. Department of Labor, Washington, D.C. 20210. Copies may also be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, price, 15 cents.

Manual Handling Methods

Accidents involving manual materials handling are primarily the result of unsafe work habits. Unsafe work habits stem from lack of training or from individual poor judgment. For these reasons, it is imperative that construction workers be trained in the safe techniques of handling materials.

1. Workers must be trained in safe lifting. Many construction workers give little or no thought to the matter of lifting until they meet some exceptional lifting problem or are injured through the use of wrong lifting methods.
2. The weights which each person can safely lift are limited by his physical condition, build, and stature, and by his training in lifting heavy objects.
3. Supervisors should use information from physical examination records, personal discussion, or other available sources in deciding which men to assign to lifting or carrying jobs.
4. Teamwork must be taught and encouraged. It is not only unsafe, but inefficient, for one person to handle a load which is "too much" for him. Training in team lifting facilitates operations and reduces injuries.

The Bureau has developed Bulletin 110, "Teach Them To Lift," which presents a comprehensive coverage on the problems of manual handling as well as a well illustrated chapter prescribing teaching and lifting techniques.

STORAGE FACILITIES

Storage on the construction jobsite has unusual aspects, compared to industrial or warehouse storage. But the problems to which the principles of recognized accident prevention measures can and should be applied are basically the same.

Among the special problems associated with construction jobsite storage are: the changing locale in many cases as material storage moves from floor to floor or from place to place with the progress of the job; the necessity for protecting the public, which is often involved; outdoor storage on rough terrain; and the fact that any jobsite storage is a temporary situation, lasting at most only for the duration of the job.

Good storage involves the related operations of housekeeping, manual and mechanical materials handling, vehicle operation, programing, etc.

Specifics to be considered and prepared for include the following:

1. Materials stored inside a building under construction should be kept well clear of floor openings.
2. Materials stored on any floor above grade should be well back from exterior edges (unless there is a wall which extends above the top of such materials).
3. Ample factors of safety should be applied to floor loads.
4. Materials should be separated by kind, length, size, amounts, etc.
5. Storage should be as close as practical to the points where materials will be used.
6. Storage should be arranged so materials can be reached in the order needed.
7. Piling and stacking should be done in a stable and secure manner, and so that materials may be easily reached or moved.
8. Level or properly prepared or corrected surfaces should be used.
9. Mechanical equipment should be used whenever practicable.
10. Training should be given in efficient manual handling procedures.
11. Materials should be protected from weather damage.
12. Protection, as needed, should be provided from fire and undue heat.
13. Provision should be made for protection from excessive cold.
14. Protection from mechanical damage should be given full consideration.
15. Protection from theft or from damage due to attempted theft should be provided.
16. Storage facilities should be located so that they do not interfere with other operations, traffic, etc.
17. Ample illumination, both natural and artificial, should be planned for.
18. Stability of existing structures should not be endangered by storing material against their supports.
19. Only authorized persons should be permitted in storage areas.
20. Arrangements should be made for disposal of surplus or damaged materials and waste.
21. Smoking regulations and other personnel controls should be enforced, where applicable.

22. Protection of the public should be the paramount consideration when storage is on, over, or even near job boundaries.
23. Highly flammable or other dangerous materials should be specially stored and cared for.
24. Fire extinguishers and other protective equipment, as needed, should be provided.
25. Once safe conditions and methods have been established, their continuance should be required.

PERSONNEL FACILITIES

Many diseases, such as typhoid and dysentery, can be transmitted by contaminated drinking water, multiple use of personal drinking facilities, and lack of proper sanitation.

Drinking water should be obtained from a community water supply when one is available. Water from streams, springs, and wells should be tested and approved for use as drinking water by the local public health authority prior to use, and such sources should be maintained in accordance with their regulations. When nonpotable water is available on or near the jobsite, warnings of its nonpotability should be prominently posted.

Pail and dipper combinations should not be used, because they are unhealthful. Dispensing containers and tanks with paper cups are very inexpensive, and a wide variety of this type of equipment is available. Containers requiring ice should be of the type which cools the water without coming into contact with it. All of this equipment should be sterilized often and regularly. Fountain-type water dispensers with orifice guards to prevent mouth contact are very satisfactory.

Sanitary *toilet facilities* on the jobsite are another important adjunct to health protection. On those jobs where sewage lines are available, immediate hookup should be arranged and flush-type toilets provided. The Associated General Contractors of America suggests 1 toilet for each 15 employees.

When community sewage lines are not available for hookup to jobsite toilet facilities, commercially operated rental-and-service "privies" are now obtainable in and near all larger communities. Where these are not available, ample provision should be made of clean, regularly and properly maintained "privies." Installation of privies is regulated by public health authorities in many localities. Such regulations should be followed where they exist, and equivalent precautions taken where they do not.

Washing facilities are another important matter in worker health planning in the construction industry. This is a somewhat "flexible" matter which is, in large measure, dependent upon the individual circumstances of each job. However, the standard should be those facilities which are best under the circumstances to maintain healthful and sanitary conditions. Certainly, the common towel should be prohibited. Disposable or individual towels should always be provided.

When proper *eating facilities* are planned for the jobsite, the applicable regulations of the job locale should be applied as minimum standards.

Medical services. The size of the job, the type of operation involved, and many other variables govern what medical services should be provided. A minimum would be the provision of ample and proper first-aid supplies and the training of assigned persons in their use. Also, definite arrangements should be made for doctor, ambulance, hospital, and similar services. Larger jobs, of course, would warrant first-aid stations, project nurses, full-time physicians, infirmaries, etc., particularly when remotely located.

Transportation sometimes is a factor in planning personnel services. In such instances, if State regulations on crew trucks exist, they should be taken as a minimum standard. In localities where there are no such regulations, the arrangements should follow the readily available safety standards, guaranteeing every possible precaution against injury and providing reasonable comfort for the workers involved.

Proper shelter from adverse conditions should be arranged, particularly from cold and wet weather. Heating facilities should be effective and safe. In hot weather, protection from the sun should be provided to the greatest degree possible, and protection from heat exhaustion may be necessary. Salt tablets and an ample supply of pure drinking water are among the essentials.

To summarize, proper planning will prevent impairments to both safety and production which may be caused by poor personnel facilities. A healthful atmosphere which will provide improved safety and contribute to the general efficiency of the job should be provided.

WORK AREAS AND SURFACES

Falls cause more injuries on construction jobs than any other category of accidents. A greater degree of safety on jobsite work surfaces and work areas will help to reduce these injuries. Ad-

vance planning for safety in your operations will go far in helping you reduce the hazards of work surfaces.

Surfaces and areas which must be considered in safety planning are walkways, stairs, wall openings, floor openings, scaffolds, ladders, floors, ramps, platforms, work surfaces, and spacing. The observance of standards and codes, where applicable, will go far in reducing falls. It is just about as expedient to construct a "temporary" ladder, stairway, or ramp "according to code" as it is to make up a clumsy, makeshift, unsafe substitute. It takes only minutes to erect a satisfactory barricade around a floor or wall opening. Safety-checking a swing scaffold takes only a few minutes, but it can save injury and loss due to its falling.

These are a few examples of the many items to be included in your planning for safe work areas and surfaces on the jobsite.

MECHANICAL EQUIPMENT AND GUARDING

Construction equipment is important in jobsite safety and it influences the environment in which the work is performed. Provision should be made for the equipment to be properly guarded. All pertinent State and local regulations governing the guarding of mechanical power transmission apparatus and points of operation should be complied with. Additional information on machine guarding is available from State labor departments, American Standard Safety Codes, and other sources. One excellent reference is Bulletin 197, "Principles and Techniques of Mechanical Guarding," issued by this Bureau. Single copies are available, upon request.

One compelling reason for effectively guarding mechanical equipment is that there is no way to keep an operator's mind on his work all the time. A dangerous mechanical condition will eventually catch him off guard during one of these moments. The more effectively the hazard is controlled, the less chance there is of injury.

The statement that men, not machinery, cause most accidents and injuries can be very misleading.

Both mechanical hazard and faulty behavior are involved in nearly every injury. The large number of injuries and the high proportion of deaths and permanent disabilities arising from mechanical equipment are adequate evidence of the importance of machinery safeguarding.

A mechanical safeguard should meet several standards: (1) it should provide full protection to the operator, fellow workers, and

passersby; (2) it should afford maximum protection for repairmen; (3) it should be interlocked (where applicable) so that the equipment is inoperable unless the guard is in place; (4) it should be arranged to permit safe oiling, repair, and adjustment; (5) it should be strong enough to resist wear and abuse and to retain broken machine parts in case they fail; (6) it should not create any hazards of its own; and (7) it should not interfere with efficient operation of the equipment. Properly designed guards give steadier and more reliable function of equipment.

Some of the fundamentals to bear in mind when designing or ordering guards are:

1. While the specific size of any opening in a guard should be obtained from the standard table, the following "rule of thumb" may be used:
   a. Where a finger may reach through a guard to a moving part, any opening should be limited to 3/8 inch in its smallest dimension.
   b. Where moving parts are beyond finger reach, openings should not be over 2 inches, in order to keep hands out.
2. A guard about a point of operation should permit a satisfactory view of the point of operation so that the operator will not be inclined to remove it.
3. Openings left for oiling, repairing, or adjusting should have hinged covers which fasten firmly.

Construction equipment does *not* have to cause injuries. Proper planning, followed by effective implementation of the plans, will produce safer guarding and operation of jobsite equipment, thereby reducing the injuries which such equipment causes.

JOB HOUSEKEEPING AND SANITATION

One fundamental rule of good job housekeeping on the construction site is that cleanup should be considered a part of the operation, rather than a separate, periodic activity. In other words, the proper time to clean up debris, scrap, etc., is as soon as possible after it has been created.

This is essential because poor housekeeping increases fire and accident hazards and also reduces the efficiency and speed of the operation. This policy of integrating good job housekeeping into all operations does not eliminate the need for periodic inspection and systematic cleanup, such as an end-of-the-day cleanup or weekly checkup.

Many accidents which are charged to other causes, such as tripping or slipping, actually are the result of unsafe conditions produced by poor housekeeping.

Some examples of poor housekeeping on the construction job which can lead to accidents are:

Loose objects on floors or ground—tripping hazards.
Slippery material on floors—slips and falls.
Loose objects overhead—may fall on workers below.
Large objects out of place—can be bumped against.
Insecurely piled materials—may fall on workers.
Improperly placed tools—contact with sharp edges.
Projecting nails—may puncture or scratch.

Five good rules for good jobsite housekeeping:

1. Keep stairways, passageways, and gangways free at all times from materials, supplies, and obstructions.
2. Secure loose or light material stored on roofs or on floors that are not closed in.
3. Pick up tools, material, or debris which may cause tripping or other hazards.
4. Remove empty bags or other containers which have held lime, cement, or other dust-producing material from work areas.
5. Remove, hammer in, or bend over protruding nails in boards and timbers.

Planning for safe housekeeping on the construction job must include:

1. Orderly arrangement of processes, operations, and equipment.
2. Provision of a definite place for each object.
3. Adequate disposal of scrap, waste, and surplus materials.
4. Cleanliness of the work area and equipment.
5. Provision of sufficient working space.

To achieve effective jobsite housekeeping:

Management should include housekeeping in the planning of all operations by setting up control and cleanup measures and by regulating work practices, include maintenance of good housekeeping as part of individual job responsibility, provide cleanup schedules and personnel, and maintain executive supervision and interest.

Supervisors should maintain a constant check on housekeeping conditions, have unusual situations corrected or cleaned up immediately, see that employees maintain good housekeeping, plan for orderliness in their operations, issue definite instruction to their crews, and insist on cleanup after every job.

Employees should follow instructions on maintaining good housekeeping, and promptly report any poor housekeeping conditions they may find.

HANDTOOLS AND POWER TOOLS

The severity of handtool injuries in the construction industry is relatively low; unfortunately, however, the frequency rate for handtool injuries is relatively high—representing about 7 percent of all injuries. The end result then is a considerable loss in the efficiency of jobsite operations as a result of these injuries. The seriousness of handtool accidents is attested by continuing attention from those construction companies which have developed meaningful safety programs.

Handtool injuries, like all others, can practically be eliminated if the wish to do so is strong enough. The effort will not be effective unless all tools are made properly and maintained in a safe condition, and unless proper methods of use are prescribed and required.

Three principal causes of handtool injuries are (1) using defective tools; (2) using the wrong tool; and (3) using a tool in the wrong manner.

Measures for preventing injuries from defective tools include:

1. Distribution control—a system whereby tools are issued through a central point of control, with provision for maintenance and replacement.
2. Tool inspection—even the best controlled distribution and maintenance cannot be fully depended upon. A system of inspection should be set up both for tools in use and those in stock.
3. Where workmen furnish some or all of the tools they use, the problem of eliminating defective tools is not an easy one. But management can and should require that workmen procure safe tools and maintain them in a safe condition. In addition, management should inspect tools, even though the tools may be the workmen's personal property. In some cases, the workmen are given the option of using company tools or their own; whether tools are owned by the worker or the company, some planning should be devoted to a means for tool control to eliminate defective tools on the jobsite.

With regard to (2) and (3) above—using the wrong tool or using a tool in the wrong manner—prevention is admittedly diffi-

cult. However, there are several effective approaches to this problem:

1. *Training.* Instruction in the safe use of tools should be given to all workers.
2. *Supervision.* It is as much the supervisor's duty to see that men work safely as it is to see that they work effectively.
3. *Layout.* Work to be done should be placed or protected so that it does not present a hazard to either the worker or others nearby.
4. *Personal protection.* Protective equipment (goggles, etc.) should be provided and required where needed.
5. *Sheaths.* Sheaths and carriers should be either provided or required.
6. *Safe storage.* Hangers, shelves, holders, or similar means should be used to protect tools when not in use.

The foregoing discussion is intended to relate to not only ordinary handtools (saws, etc.) but also to powered handtools, welding torches, and similar miscellaneous equipment.

The tremendously expanded use in the construction industry of powder actuated tools makes a separate treatment of this category entirely appropriate.

In safety planning for this class of tool, the following points should be considered:

1. Arrangements should be made with manufacturer to have his training instructor teach all persons who are to use this tool.
2. Persons instructed in the use of a certain manufacturer's tool should be considered competent in its use only.
3. Only trained and authorized personnel should be permitted to handle powder actuated tools.
4. Records should be kept of the names of certified operators, the type of tool certified, and the name of supervisors responsible for the tool's care and use.
5. Loaded blank cartridges should be kept and transported in a locked container under the direct custody of authorized personnel. Misfired cartridges should be so handled until disposed of.
6. A thorough study of each specific job should be undertaken to insure that an unnecessarily heavy charge is not used.

Powder actuated tools are extremely hazardous if improperly handled—they should be treated with the same respect as firearms. Compliance with the recommendations of the Powder Actu-

ated Tool Manufacturers Association and applicable standards of the American Standards Association is strongly urged.

In conclusion, advance planning for provision of the right tools and for their cleaning, sharpening, adjustment, repair, storage, transport, inspection and proper use will help make work on the construction jobsite easier, better, and safer.

FIRE PROTECTION AND CONTROL

The fire risk for building construction is generally rated high by the insurance companies. Both the number of fires and their severity can be reduced by proper planning to offset the hazards involved.

It is not at all uncommon to find some or all of the following conditions on construction jobs: (1) inadequate provision or no provision for fire control training, facilities, or equipment; (2) unsafe storage or care of combustible materials; (3) inadequate inspection methods; (4) unsafe practices; (5) inadequate control of heat and ignition sources; and (6) poor housekeeping. These are the areas to which prior planning and supplementary activity must be directed if the fire hazards on the jobsite are to be reduced.

Essentially, five objectives form the foundation upon which the jobsite fire control program should be established:

1. Prevention of fires.
2. Provision for early detection.
3. Control of spreading.
4. Provision for prompt extinguishment.
5. Plan for prompt and orderly personnel evacuation.

Predominant causes of construction fires include smoking and lighted matches, electrical hazards, rubbish, flammable liquids, and open flames and sparks.

Most fires, except those involving explosions, begin as small ones. At first, extinguishment may not present much of a problem, but the fire can and often does grow very rapidly. Prompt detection and sounding of an alarm are, therefore, of great importance to permit prompt evacuation of workers and to summon those who have been trained in and charged with the duty of extinguishment.

It is important to confine fire to the smallest area possible. On a construction job, this presents a greater problem than it does in many industries which can establish at least relatively permanent fire areas. On a construction job, because of the daily

changing pattern of the premises, the principles of isolation and confinement must be utilized to the greatest degree possible; e.g., isolating flammable liquids from other easily combustible storage, confining the welding operation behind a shield, etc.

In planning means for prompt extinguishment of fires, the first step is to understand the classification of fires.

Class A—Fires in ordinary combustible materials, such as wood, paper, fabric, etc., where quenching and cooling is the method of extinguishment.

Class B—Fires in flammable liquids and gases where exclusion of oxygen is the common method of extinguishment.

Class C—Fires in or near live electrical equipment where the extinguishing agent should be "nonconducting."

Class D—Fires in certain active metals which require special extinguishing agents and methods.

Following is a summary of the characteristics and specifications of approved extinguishers in the most commonly used sizes.

Characteristics of Common Fire Extinguishers

Type of extinguishers	Class use on	Rated size	Horizontal range (in feet)	Method of operation	Time of discharge (in seconds)	Effect
Soda-acid	A	2½ gal.	30–40	Invert	60	Quenching and cooling
Pump-tank	A	5 gal.	30–40	Hand pump	100	
Stored pressure	A	2½ gal.	30–40	Open valve	60	
Gas cartridge	A	2½ gal.	30–40	Invert and bump	60	
Loaded stream	A–B	2½ gal.	30–40	Invert	60	
Foam	B	2½ gal.	30–40	Invert	60	Excludes oxygen
Carbon dioxide	B–C	15–25 lb.	6–8	Open valve	30–60	
Dry chemical	A–B–C	15 lb.	15–20	Open valve	20	

Note: The figures on maximum horizontal range should not be taken as the effective range of the extinguisher. Effective use of extinguishers calls for relatively close approach to fires. In those cases where approach to a fire is limited by heat, it is questionable whether a portable fire extinguisher would be effective.

Summing up:

1. Extinguishers listed by a nationally recognized fire equipment testing laboratory should be provided.
2. The right type of extinguisher should be available for each class of fire that might occur.
3. Enough units to afford full protection should be procured.
4. Extinguishers should be located so as to be readily accessible for immediate use.
5. Arrangements should be made for periodic inspection, recharging, and maintenance of extinguishers and for protection against tampering.
6. Fire hose connected to an ample water supply should also be provided in all areas possible.
7. Personnel should be told of extinguisher and hose locations which should be marked by signs visible from all directions.
8. Training in fire control should be provided.

Evacuation of personnel is more difficult on a construction job than on most industrial operations. As the job progresses, this problem, in most cases, becomes more acute. The "openness" of the average construction operation might lead to the belief that evacuation would not be a problem; however, experience proves the contrary. Construction workers should be properly educated in what to do in event of fire or similar emergency, and this training should go into the planning for fire control on every construction job. Personnel evacuation should take precedence over other aspects of fire safety on the construction site.

OCCUPATIONAL DISEASE PREVENTION

Throughout industry, including construction, injury prevention has come to include the prevention or control of occupational disease. This is true not only in fact and by logic, but, in many jurisdictions, as a matter of law.

Occupational health hazards might be generally defined as those which are caused by nature of the work and the environment in which it is performed to differentiate from traumatic hazards. Examples include work involving temperature extremes, excessive noise, or toxic vapors, gases, fumes, or dusts.

In short, control of health hazards is an integral segment of providing a safe workplace.

Evaluation of these hazards depends on (1) the type and nature of the condition or substance; (2) possible intensity of exposure;

(3) duration of exposure; and (4) the physiological response of the body.

Results of the evaluation process form the basis for either eliminating or controlling the health hazards found to be either actual or potential.

Much information is available to assist planners; for example, the following publications of the Department's Bureau of Labor Standards:

Bull. 198—Occupational Health Hazards.
Bull. 207—Controlling Noise Hazards.
Bull. 231—Personal Protective Equipment.
Bull. 226—Respiratory Protective Equipment.
Bull. 211—Control of the Physical Environment.

PROTECTIVE MAINTENANCE

Proper maintenance of machinery and other equipment has several names: routine, periodic, procedural, preventive. All these terms are embraced in the phrase, protective maintenance. Investment in good maintenance of equipment on your jobsite will help protect both operating and maintenance personnel, as well as the equipment itself from unnecessary damage, disrepair, or failure. Proper maintenance assures maximum operating time of construction equipment at minimum cost. Poor maintenance leads to injuries to personnel and costly damage to equipment. Protective maintenance offers the safety planner on the construction jobsite a very fertile field for providing a safe and efficient environment.

Two types of maintenance procedures should be developed as part of advance planning for safety on the jobsite: (1) the day-to-day aspects for which procedures should cover standard maintenance activities, including formulation of work schedules to cover repetitive operations, such as lubrication; and (2) a maintenance program based upon regular and systematic inspection of equipment and machinery, including periodic replacement schedules for essential parts, keeping useful records, and, of course, making repairs when inspection reveals their need.

On the construction job, the principles of protective maintenance—and a planned program for their application—should be directed to hoisting equipment, tools, machinery controls, guards on machines and equipment, electrical equipment, etc., to name a few.

Another Bureau publication dealing with this subject in more detail is Bulletin 246, "Maintenance and Safety."

PERSONAL PROTECTIVE EQUIPMENT

Personal protective equipment, whether it's face, eye, foot, respiratory, etc., is designed to prevent or minimize injury, rather than to prevent accident occurrence. Protective equipment is only a last defense against injury; it does not in any way eliminate or reduce the need or importance of preventing accidents which cause injuries.

Much research, study, testing, and experimentation have been devoted to the development of effective personal protective equipment, which is now available to protect workers in the construction industry from many hazards.

For advance planning and future use of protective equipment, certain essential steps are:

1. An appraisal of potential hazards. The appraisal should review past injury occurrences on the type job being planned, and whether personal protective equipment or clothing might have prevented or minimized those injuries.
2. Types, uses, and limitations of such equipment for the specific purpose. It is important to indicate the proper type of goggle, respirator, safety belt, etc.; to be fully cognizant of how, why, and when each should be used and to know how much protection each will afford.
3. Care, storage, repair, replacement, and maintenance of the equipment so that it may continue to serve its intended purpose.

The planner needs to appreciate the contractor's problem in requiring employees to use personal protective equipment. Proper training in the use of certain equipment is important. When workers understand the why and how of such equipment, their cooperation in using it is easier to obtain. Supervisors can set an example by using the equipment themselves. Workers should also be encouraged to use protective equipment voluntarily.

Further information to help the planner obtain the best equipment may be obtained from a number of sources, including the Bureau of Labor Standards which has available upon request the following publications on this subject: Bulletin 231, "Personal Protective Equipment," and Bulletin 226, "Respiratory Protective Equipment."

ELECTRICAL SAFETY

On the construction jobsite, electrical hazards are all around the worker: the crane boom swinging near the powerline; the

portable handtool; the temporary wiring throughout; and various types of electrical equipment. The temporary and constantly changing nature of the construction job poses distinctive problems in electrical safety.

Two fundamentals of electrical protection are insulating and grounding. If these are done properly, safe work practices in the use of electrical equipment or facilities are all that are necessary to protect the worker.

Step 1 in the jobsite electrical safety program should be acquisition, provision, and installation of first-quality equipment, tools, materials, wiring, and other electrical facilities of the proper type. A minimum standard for both wiring and equipment should be compliance with the National Electrical Code. Step 2 is the direct assignment of responsibilities for selection, installation, storage, transportation, care, maintenance, repair, and control of electrical equipment. Plans should be drawn for physical guarding where necessary, such as around switchboard locations. Protective equipment—insulating gloves, special tools—should also be included in plans. And a well-conceived plan should be established for thorough, periodic inspections by qualified persons, the purpose and product of these inspections being necessary corrective action and, as a byproduct, the compilation of useful records.

More specific information may be obtained by referring to the following Bureau publications: Bulletin 216, "Control of Electrical Shock Hazards"; Bulletin 256, "Static Electricity"; Occupational Safety Aid MP-8-0, "Hazards of Low Voltage Electricity"; and chapter 20 of Bulletin 67, "Safety Subjects."

PROTECTION OF THE PUBLIC

Construction work has always attracted sightseers, even in remotely located jobs. When ground is broken for a new project, men, women, and children of all ages become curious. Besides the curious ones, the general public may have occasion to pass by, either on foot or in vehicles. Contractors increasingly seek to develop a good image of themselves and their industry. Good will of the public is not to be taken lightly, as some members of the industry have learned through bitter experience. The man who gets dust on his new coat and the one who trips and almost falls on a bad walkway floor joint illustrate situations which might result in resentment against the firm or in possible damage suits.

The general public is usually unaware of the many hazards existing in, on, and about construction projects. The planner,

therefore, needs to provide means for its protection. This obligation has a basis in the legal concept of the "attractive hazard," a concept which has been established in courts of law and equity, especially where children are involved.

Provisions should be made so that children, especially, cannot gain entrance to the work area. When this is not possible, every precaution should be taken to protect them otherwise. Barricading, grounding buckets and blades, disconnecting electricity, and covering holes illustrate a few typical safeguards. A watchman should be stationed on the premises for this purpose.

Ample public protection should be provided for all operations, but particularly for excavations which enter, follow, cross, or are adjacent to public thoroughfares. Vibration, such as that caused by piledriving and blasting, should be anticipated and offset. Most common, of course, are the building construction operations at the typical urban jobsite. Here, full use can be made of flares, lighting, barricades, fences, sidewalk sheds, special walkways, bypasses, and all other means of providing public protection.

Some companies develop an "advance rapport" with the public by erecting large signs announcing what is to be built, why, etc.; *and* soliciting the public's indulgence for any inconvenience the work might cause. One utility—undoubtedly there are others—distributes a folder in the area affected, describing how "Construction of —— —— —— will begin shortly in your vicinity." Included in this folder is an explanation of why the work is necessary, what will happen while men are working, the care which will be taken to preserve property, what the results will be, benefits provided, and the fact that any inquiries about the job should be made to the man in the "Blue Hat," and would be most welcome. (This company's hard hats are all "coded.") The possible results of such an approach to the public relations problem are obvious.

Failure to protect the public from injury can subject the contractor to liability claims, awards for which have risen considerably. He can, and should, do the necessary advance planning to offset this possibility.

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