

such cases, it is especially important that the safety professional seek the advice and help of personnel within the company who are responsible for establishing engineering design criteria and for setting up job procedures.

The ultimate objective of all the company's engineering personnel is to design equipment and processes and to plan job procedures so that exposure to injury is eliminated or controlled. It is the safety professional's job to see that engineering personnel are acquainted with the particular hazards involved and the methods of eliminating them.

The safety professional should be able to discuss with management and the various supervisors involved the conditions responsible for accidents or potential accidents. He might well remember that, in making his corrective suggestions, he will be more successful if he can demonstrate that an injury is only one of many hindrances to efficient production.

The safety professional who has the necessary knowledge and skills for preventing accidents should be able to make recommendations for effective use of the facilities at hand for more efficient as well as safer production.

Unsafe acts, unsafe conditions

In most industrial accidents, *both* an unsafe condition and an unsafe act are contributing factors. In almost 80,000 work injuries reported in Pennsylvania in 1960, an unsafe condition was identified as a contributing factor in 98.4 percent of the nonfatal manufacturing cases*. In the same study, an unsafe act was identified as a contributing factor in 98.2 percent of the nonfatal manufacturing cases.

It must be remembered that an unsafe condition, in addition to being a direct cause of accidents in itself, often can lead people to perform unsafe acts. Many times, an unsafe act is the result of poor machine design, inadequately planned methods, and other engineering deficiencies. Thus, elimination of a hazard caused by an unsafe condition may also reduce the likelihood of injury from an unsafe act.

When an injury occurs, the unsafe condition is often not as glaringly evident as the unsafe act. Unless a careful study is made of the accident, the correctable physical hazard may escape notice.

Engineering for safety, therefore, should have as objectives both the elimination of hazardous conditions and the elimination of unsafe acts.

Machine Design

Machinery ranks fourth as a source of disabling work injuries, accounting for about 10 percent of all such injuries. Further pointing to the need for safe design of machines is the fact that they rank second as a source of permanent partial injuries, according to NSC's *Accident Facts*.

The design of machinery and equipment is an evolutionary process. It is always changing and dynamic, because design engineers constantly acquire wider experiences in the course of their everyday work. These experiences give them a broader scope and more initiative at the drawing board. This initiative, however, will be disciplined by the practical consideration of designing the most effective means for controlling hazards in the operation of machines or equipment.

Basic considerations

Evidently, the design of machinery must be further improved if the number of injuries caused by machines is to be reduced. How hazards can be eliminated from machines in the planning stage is illustrated by much of the evolution in machine design that has thus far occurred (Fig 5-3). Behind this evolution has been the search for ever-increased efficiency and safety in machines of all types. In repeated instances, innovations in design which improved efficiency also eliminated or lessened a hazard. Conversely, measures taken to prevent accidents also improved production efficiency.

Policy in designing or purchasing should make sure that a machine is so designed that it will meet the requirements promulgated under authority of the OSHA Act. Adding guards to control exposure to injury after the machine has been installed is usually expensive and second best.

*Pennsylvania Department of Labor and Industry, Harrisburg, Pa. *Industrial Injuries in Pennsylvania* 1960.