

## FATIGUE

The term 'fatigue' is commonly used to denote a decrease in the capacity or efficiency of a person to do the work because of previous work. The two important implications of fatigue are :

- (a) It is generally physiological in nature whereby lactic acid is accumulated in the blood resulting into breakdown of tissues.
- (b) It reduces the capacity of a person to do work leading to fall in production.

Fatigue is perhaps the most important problem handled by the industrial engineers. Fatigue is a sort of negative appetite for work. It affects the worker's muscles, nerves and mind. In the words of Harrell, "Fatigue, or activity decrement, means a reduced capacity for further work as a consequence of previous activity where a person was trying almost as hard as he could."<sup>5</sup> Fatigue improves both physical and mental reactions to the efforts put in at any activity. "Fatigue is synonymous for tiredness. Nevertheless, fatigue does not arise solely from exhaustive physical and mental efforts on the job. Other factors being equal, fatigue will be greater with greater expenditure of effort, either physical or mental."<sup>6</sup> Thus, fatigue connotes reduced capacity to work which arises because of expenditure of physical or mental effort on the work already done.

### **Monotony vs. Boredom**

According to Harrell, "Monotony is a state of mind caused by performing repetitive tasks. It implies no emotional dislike. Boredom or lack of interests is characterised by depression and a desire for a change of activities. It is tinged with emotional distaste and is accompanied by a corresponding attitudinal outlook. Thus, boredom is more heavily affected by such factors as personality, attitude, interest patterns than is monotony. On the other hand, boredom can be differentiated from fatigue because it is desire for a change in activity rather than for a rest or for relief from work all together."<sup>7</sup>

Monotony is a state of mind or an attitude of a worker towards his job which is caused by performing repetitive task. For instance, a worker is doing a job which needs constant watch, but does not keep his mind fully occupied,



monotony is most likely to occur in this case. But boredom, on the other hand, denotes a lack of interest in the task assigned to a worker. The mind of the worker is depressed and he desires a change in work. There is certain degree of emotional dislike of work by the worker. Boredom is different from fatigue in the sense that a bored worker desires change in the task. But a fatigued worker desires rest or relief from the work. Boredom is heavily affected by personality, attitude and interest patterns of the worker. Boredom can be removed by allowing the worker to change from one operation to another and monotony can be broken by enlarging the job.

### **Fatigue vs. Boredom**

The distinction between the two terms is discussed below ;

1. Fatigue is usually associated with psychological depletion while boredom is concomitant of mental dullness.
2. Fatigue is a decreased capacity for work. Boredom is a decreased interest in work.
3. Fatigue is conscious inability. Boredom is a feeling of incapacity with or without there being a psychological basis for the feeling.
4. Fatigue expresses itself in the form of a gradual decrement in the work curve with a final end spurt. boredom expresses itself in the form of irregularities in the work curve with intermittent spurt of shorts duration, a sharp drop in the work curve during each work spell and a rapid rise toward the end.
5. Fatigue is, to some extent, measurable. Boredom is a subjective attitude that defies objectives evaluation.
6. Fatigue expresses itself in the desire for rest. Boredom expresses itself in the desire for change.

### **Symptoms or Indicators of Fatigue**

Fatigue represents decline of output for a given level of effort, a feeling of tiredness, and physiological change which include the following :  
(a) accumulation of lactic acid in the blood which is caused by breaking down of glycogen or sugar in the blood : (b) changes in the function of the nerve and muscle cells : (c) changes in the nerve fibre to conduct itself normally : and (d) changes in the brain. Simply stated, fatigue may be of two types : *normal* and *cumulative*. Normal fatigue is simple tiredness which is overcome by rest. Normal fatigue is not as important as cumulative fatigue. Cumulative fatigue results from overstrain, caused by too much work, or overstraining. The existence of cumulative fatigue can be revealed by the following indicators :

- (i) the rate of absenteeism and labour turnover ;
- (ii) the rate of accidents, particularly during the latter part of the day or week ;
- (iii) percentage of rejects, rework and spoiled work ;
- (iv) reduced productivity ; and
- (v) general attitude of workers towards their work, management and the organisation.



## Causes of Fatigue

Fatigue can be known by studying the feelings of the fatigued person. An individual may 'feel' completely rested, but his work record may show a rapid decline. Under conditions of strong motivation, people may continue to work for long period of time without being aware of fatigue, whereas under other conditions they may feel fatigued before they go to work. The various signs of fatigue include inefficient eye movements, closing the eyes, looking about, strain in muscles and nervous system, etc. The important cause of fatigue are as follows ;

1. Long hours of work without suitable rest pauses.
2. Faulty layout of machines and equipment.
3. Lack of adequate space for the worker to move freely.
4. Environment factors such as excessive noise, poor lighting, improper ventilation, etc.
5. Poor health of the worker.
6. Lack of proper training leading to unnecessary movement.

## MEASUREMENT OF FATIGUE

Angelo Masso, an Italian scientist, was the first to develop an instrument known as the "ergograph" which made it possible to investigate the relation between fatigue and work in a relatively isolated part of the body. He was able to induce fatigue in a muscle group and could study the phenomenon without complicating it greatly with such psychological effects as monotony and boredom which are likely to accompany longer periods of work.

The principle of the ergograph is simple. All fingers except middle are similarly immobilised. A string is then fastened to the free finger which is to be put to work. By placing a load on the end of the string, the free finger can be made to pull against the load. In Masso's apparatus, the string is tied over a pulley and the finger pulls against a known string tension. The work of the finger is done by contracting and relaxing the muscles, which, in turn, lifts and lowers the weight. In order to obtain a graph of the work output, a recording device is fastened to the moving string. Each contraction carries successive contractions by a series of straight lines.

The use of the ergograph has established a number of important relationships, each of which has a definite application to the industry and are discussed as follows :

1. If the contractions with a given load are spaced one every two seconds, there is a gradual decrease in the amplitude of the contractions until finally no further contractions can be made.
2. If the contractions with a given load are spaced 10 seconds, there is no apparent evidence of fatigue.
3. If the load is lifted in a fast rhythm, it produces more fatigue for lift than the same load lifted at a slower rhythm.
4. The time for complete recovery increases rapidly as the period of work is increased.

5. The activity of other sets of muscles reduces the ability of the finger to do work.
6. The ability of the muscle to do work is decreased by loss of sleep, mental activity, hunger and failure of the muscles.
7. The ability of the muscle to do work is increased by massaging the muscle, injecting sugar into the blood stream and by good health and nourished body.
8. The rate of fatigue differs greatly in different people.



# EMPLOYEES' HEALTH AND SAFETY

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## Rationale of Good Working Conditions ✓

Working conditions have attracted a great deal of attention of managements of business and other organisations in the recent years. There are two basic reasons for this. *Firstly*, the growth of trade union movement has compelled the managements to provide better working conditions to the employees. *Secondly*, enlightened managements realise the significance of better working facilities to the employees for achieving greater productivity and efficiency in the organisation. An employee spends about 8 hours at the place of work during any working day. He must be provided with such types of facilities which will maintain his health and keep him interested in his work.

There are many repercussions of not providing good working facilities to the employees. *Firstly*, the employee will not be able to concentrate on his work. *Secondly*, he will not feel like putting his best if the working conditions are not good. *Thirdly*, bad working conditions will tell upon the health of the average employee and will cause him to abstain from his work. *Fourthly*, there will be higher rate of absenteeism and labour turnover. *Finally*, there will be wastage of resources of the organisation because of lower efficiency. The quality of work will also deteriorate. Therefore, in order to avoid these ill-effects of bad environment, the management should ensure good working conditions to the workers.

## Types of Working Environment

The factors which cause individual differences among people fall into two categories, viz., hereditary and environmental. Hereditary factors mainly determine physical traits such as height, weight and strength, while environmental factors generally have a dominant influence on personality traits and interests. By environment is meant physical, mental and social surroundings in which a worker performs his task. Industrial psychology attempts to study all the three types of environment as discussed below.

✓ (a) **Physical environment.** It consists of the physical factors prevalent within the factory. It comprises lighting, ventilation, temperature, humidity, layout of machines, noise, etc. Inadequate light, for example, causes strain on eye-sight of the workers. Poor ventilation and absence of fresh air makes people uncomfortable at work. A worker's efficiency will be very low if he does not have physical comforts. Even the degree of moisture or humidity in the air will affect his speed of work. If the required moisture is not present in the air, it has to be artificially created. Similarly, unnecessary noise is also harmful to worker's health. Besides, unwanted noise distracts his attention from work.



(b) *Mental Environment.* Mental strains caused among the workers while at work adversely affect their efficiency. Mental environment is very much concerned with the psychology of workers. It includes various instincts of the workers like fear, anger, etc. Favourable mental environment should be created for the satisfaction of the workers and to boost their morale.

(c) *Social Environment.* Every individual's way of doing things is to a large extent affected by the society in which he moves. His thinking as well as performance are affected by his social environment constituting the groups of persons he is associated with. Management should attempt to create better relations among the employees and form groups of like minded people where group effort is needed. This would enable the workers to co-operate with one another as well as with the management.

## PHYSICAL ENVIRONMENT OR HEALTHY WORKING CONDITIONS

It is essential to ensure favourable working conditions so that the workers can perform their tasks without experiencing physical or mental strain. The ILO Productivity Mission to India emphasised in its report that productivity can be increased simply by improving the working conditions before any method study technique is applied. Bad or unfavourable working conditions mean loss of time, waste of materials and loss of output.

Some of the conditions surrounding a worker as he does his job and affecting his physical well-being and thus his efficiency, are as under :

(i) *Cleanliness.* It is essential for health. Dirt should be removed daily from all rooms, passage and stair-cases. Sufficient spittons should be provided at convenient places and should be kept hygienic, properly cleaned and disinfected. Rats, other pests and insects should be destroyed as they are the worst carriers of diseases.

(ii) *Lighting.* Good lighting can facilitate higher production. It is essential to the health, safety and efficiency of workers. Without proper lighting, eye damage will occur, accidents and spoilage of material will increase and production will slow down. The efficiency of light depends on both its quantity and quality. Factors determining quality of light include glare, uniformity of distribution and brightness. A good system of lighting should provide : (i) the right degree of intensity of light according to the job to be done ; (ii) the light is well diffused and is spread uniformly over all parts of the work-place ; and (iii) protection from any glare, either directly or indirectly.

Worker's efficiency directly depends on his ability to see the objects quickly and accurately. Thus, lighting must be adequate and free from defects. Adequate and proper lighting ensures accuracy of workmanship which results into better quality of the product and less spoilage and re-work. Workers need not strain their eyes if lighting is adequate.

(iii) *Temperature and Ventilation.* The employees must be provided tolerable temperature if they are to work efficiently. Their efficiency is bound to suffer if the temperature of the work place is either too low or too high. Steps should be taken to ensure flow of fresh air having right temperature and humidity. Coolers can be used during the summer ; and heaters can be used during the winter.



Proper ventilation is necessary to ensure the circulation of fresh air and to remove congestion in the plant. If the ventilation arrangement is not provided, the air will become stale and cause headache to the employees. The employees will feel tired and sleepy. This will reduce their efficiency. Electric fans, exhaust fans and air conditioners can be used to regulate temperature and ventilation in the office. Electric fans circulate fresh air and exhaust fans expel the stale air.

Air-conditioning may be used to regulate and control any or all of the following :

- (i) Circulation—movement and changing of air for freshness.
- (ii) Temperature—maintaining comfortable heat levels.
- (iii) Humidity—maintaining proper relationships between moisture in the air and the temperature.
- (iv) Purity of air—filtering out objectionable particles such as dust, smoke and fumes from an enclosed area.

**(iv) Freedom From Noise.** Noise may be defined as an unwanted sound in or outside the factory. It has an adverse impact on the minds of employees staff and tells upon their efficiency. It is a source of disturbance to the employees and does not allow them to work with concentration. Therefore it is essential to keep noise under control. There are two types of noise, namely, *internal* and *external*.

Internal noise is caused by conversation, running of machines, movement of workers, clerks, peons and visitors through corridors and gangways. Noise is also created by incoming and outgoing telephone calls. Internal noise can be controlled more easily as compared to external noise. The employees can be dissuaded not to talk inside the rooms. For general absorption of noise, sound absorbent materials may be used for four walls and ceilings. Machines producing noise may be installed in a separate shed and carpets may be spread on the floors to reduce noise caused by movement of the employees.

External noise comes from outside the factory premises. It enters through doors, windows, and ventilators. The external noise cannot be eliminated. But sound-proof walls, double doors and glass panes can be used to prevent the noise from entering the premises. External noise should also be given due consideration at the time of the choice of location of the premises.

**(v) Dust.** In certain areas or regions, the ratio of dust in the atmosphere is quite high. For instance, in areas where cotton textile and jute mills are located, the atmosphere is constantly dust laden. When dust enters the factory, it affects the health of the employees adversely. Dust also reduces the life of various machines and equipments. Therefore, it is essential to check the entry of dust into the factory premises.

It may be difficult to check entry of dust into the factory. It is desirable to clean the dust on the walls and ceilings of the factory and on the machines and equipments and on the records. Dust should be cleaned quite regularly because it not only pollutes the environment but also has an adverse impact on the intensity of light. Floors, reflectors and electric installations should be cleaned regularly to get proper intensity of light in the factory and office. Big offices install air-conditioning systems which help in checking entry to dust into the office to a great extent.



(vi) **Working Space and Seating Arrangement.** Adequate space should be provided for workers, materials, tools and equipment for their free and unhindered movement from one machine or process to another. There should also be enough seating arrangement for the workers as prolonged standing may lead to discomfort and fatigue.

## SAFETY IN INDUSTRY

It is the responsibility of every management to ensure workers' safety while they are at work. Industrial safety and efficiency are directly related to a great extent. Safety measures not only result in reduced industrial accidents but also raise industrial efficiency. Therefore, employers should lay emphasis on safety measures in their plants. Moreover, rules and regulations, as laid down in the labour laws, make it obligatory on the part of industrialists to provide certain minimum measures of safety for their employees. Such measures are intended to ensure protection to workers, avoid industrial accidents and raise overall efficiency of the enterprise.

Industrial safety measures include precautionary steps to be taken by the management of an enterprise in order to prevent accidents. Thus, accident prevention is the main objective of any safety programme. Accidents in an industry cause damage to property and life. It must be pointed out that the rate of industrial accidents has been on the increase inspite of several statutory regulations imposed by the government.

### Impact of Industrial Safety on Productivity

Industrial safety has an important influence on productivity particularly in hazardous industries like chemicals and fertilizers. Safety measures prevent accidents which are disastrous to both employees as well as employers. Every effort has, therefore, to be made by both the parties to take enough precautions and prevent accidents. Surveys and studies have shown that where necessary safety measures are provided, labour productivity is much higher in such units than in others where safety measures are lacking. This is mainly because the employees perform fearlessly and with confidence when they are assured of work safety. They work without tension when safety precautions are taken and this raises the productivity of labour.

Safety measures also boost morale of workers. This helps in developing team spirit and the sense of belongingness among the employees. Safety brings consistency in production during the initial period and an upward trend in productivity in the long-run.

### What is an Industrial Accident ?

[An industrial accident is an unexpected occurrence in an industrial establishment causing bodily injury to one or more persons. Under the Factories Act, 1948, an industrial accident has been defined as "an occurrence in an industrial establishment causing bodily injury to a person which make him unfit to resume his duties in the next 48 hours."] In other words, it is an unexpected event and is always sudden. Moreover, the event or occurrence should be something to which a definite time, date and place can be assigned.



It must arise in the course of employment in a factory or an industrial establishment. However, self-inflicted injuries or injuries inflicted with the consent of a person cannot be regarded as accidents.

Some employees are more accident prone as compared to others. According to T.W.Harell, "Accident proneness is the continuing tendency of a person to have accidents as a result of his stable and persisting characteristics."<sup>1</sup> If two individuals are working on similar machines under identical circumstances, one may commit more accidents than the other. The former employee will be called an accident-prone operator.

Accident proneness is a condition in which a "human being is mentally inclined, strongly disposed, attitudinally addicted or personally destined to become continually involved in an on-going and never-ending series of accidents or injuries."<sup>2</sup> Thus, some people may be more often involved in accidents than other. In others words, they are "accident-prone." They get involved in accidents, muscular weakness, emotional instability, visual disability, recklessness, hostility and indifference. A person who is prone to accident is also known as 'accident repeater.'

Accidents are undesirable because of both humanitarian and economic reasons. Even a minor accident may bring down the morale of the workers. Whenever an accident occurs, it leads to wastage of time of the employees involved in the accident and that of the organisation. If the accident is serious in nature, it might lead to dislocation of production in the organisation. According to T.W.Harell, "Accidents are not only expensive, but they also lower the morale of the workers and in addition result in lower production."<sup>3</sup>

### **Analysis of Accidents**

Records of industrial accidents and steps taken to prevent them must be maintained systematically. Records of accidents will help in identifying areas in which further action is called for to ensure greater safety of employees and in comparing the present records with the past records. Records of accidents are also required to be maintained under the provisions of the Workmen's Compensation Act. The information to be preserved should cover the following items<sup>4</sup> :

- (a) the total number of employees in the unit who are exposed to different types of accidents ;
- (b) the severity of the accident—whether it resulted in a broken bone, a deep cut and the time that was lost as a result of it;
- (c) the kind of the work or occupation in which the employee was engaged ;
- (d) the date, time of day, and the shift during which the accident occurred ;



- (e) the total number of years during which the employee was engaged on the particular job when the accident occurred ;
- (f) personal data, including the age and health of the injured employee ; and
- (g) the immediate cause of the accident—whether it was the result of a malfunctioning of a machine, whether the employee failed to use the safety devices provided for the purpose of preventing accidents, etc.

The task of accident analysis is usually entrusted to the safety director in every establishment. The safety director must investigate and report on every accident to top management. He should make an analysis of all injuries suffered by the employees during every quarter and classify them plant-wise, department-wise and shift-wise. The causes and kinds of injuries should also be properly classified to help in devising safety measures.

Two important measures of accidents are *accident frequency rate* and *accident severity rate*. The frequency rate is "the number of time-lost accidents (or injuries which have disabled an employee) per 1,000,000 manhours worked." The severity rate, on the other hand, is "the total number of days charged or lost because of accidents per 1,000,000 human hours worked."

$$\text{Accident Frequency Rate} = \frac{\text{No. of injuries} \times 1,000,000}{\text{No. of human hours worked}}$$

$$\text{Accident Severity Rate} = \frac{\text{No. of human days lost} \times 1,000,000}{\text{No. of human hours worked}}$$

### Causes of Industrial Accidents

We may classify the causes of industrial accidents into four categories as follows :

(i) Inherent hazards. There are many jobs in industries which are highly prone to accidents. Coal mining, marine transport, quarry and construction are considered more dangerous industries as compared to communication, banking and tobacco industries.

(ii) Collison. This takes place when :

- (a) there are inadequate lighting arrangements,
- (b) furniture and equipment are placed improperly,
- (c) edges of equipment are not properly covered, and
- (d) cabinet drawers are left open.

(iii) Slip or fall on floors and stair-casings. This happens when :

- (a) the floor and staircases are wet with water, soap or oily substance,
- (b) the floor is highly polished and slippery,
- (c) the floor is covered with carpets and the carpets are torn or loose,
- (d) the telephone cables trail on the floor, and
- (e) there is lack of proper lighting

(iv) Miscellaneous causes. Sometimes, accidents occur due to :

- (a) excessive noise
- (b) lack of cleanliness,



- (c) leaking of electric cables,
- (d) either very high or very low temperature,
- (e) industrial fatigue,
- (f) machines operating at a high speed,
- (g) poor health of the workers, and
- (h) age and experience of the workers.

Industrial accidents mainly cause loss of man-days apart from other losses. Industrial accidents are also due to various human reasons such as carelessness of workers, absence of proper education and training to workers, alcoholism and drug-addiction among workers, defective plant layout, limited space for movement of workers and so on. The industrial accidents which are due to human errors can be avoided.

### Effects of Accidents

Accidents have disastrous effects on the organisation the employees and the society at large. Accidents prove costly for the organisation as workers have to be compensated and machinery has to be repaired. Besides, lost man days of the affected workers and cost of training of new workers further burden the cost of production.

Employees also suffer adversely from accidents. They face mental and psychological shock more so when they or their colleagues become physically disabled. Accidents have demoralising effect on the workers. Their morale is lowered. Moreover, the rates of absenteeism and labour turnover go up.

The cost of accidents in industry is borne by the society in general and the consumers in particular. Industrial accidents affect the health of the workers adversely. Sometimes they also affect the general public adversely. The Bhopal Gas leak tragedy in 1985 is a case in point. Thousands of people were killed and several thousands became disabled in this accident. Thus, efforts should be made to avoid industrial accidents in the interest of workers, employers and the society at large.

### 5 Measures for Ensuring Industrial Safety

There should be a Safety Director in every industrial undertaking to design and operate the safety programme. The basic objective of the safety programme should be safety and security of the lives, health and welfare of the workers employed therein. The following precautionary steps may be adopted to prevent accidents in the industries :

(i) **Safety Committee.** Safety committee may be constituted in every plant. It should consist of the representatives of both the management and the workers. All the safety programmes should be implemented through the safety committee.

(ii) **Safety Training.** The supervisors should train the new employees in safety methods. The possible causes of accidents should be explained to the new employees and they should be taught habits and motions that will keep them out of danger. Training programmes should also be designed for the supervisors.

(iii) **Material Handling Equipments.** Material handling equipments should be installed to carry bulky materials from one place to another. No worker may be required to lift or carry heavy loads which may cause injury.



(iv) **Guarding of Machines.** Safety guards should be designed, constructed and used to provide positive protection, prevent access to the danger zones during operations, avoid inconvenience in operation and give protection against unforeseen contingencies. These are in the form of hard insulated covers provided to the moving or rotating parts of machines.

(v) **Maintenance of Plant.** The plant should be maintained in good condition. All objects likely to obstruct the passages meant for movement by workers should be removed. Passages should not be used to store goods or materials. Dry, clean and ventilated store rooms with suitable racks, shelves, etc. should be provided for keeping electrical and other hazardous equipment.

(vi) **Regular Inspection.** There should be regular inspection of machines and equipment and electricity cables to check any leakage.

(vii) **Equipment Redesign.** Industrial engineers should be engaged to improve the man-machine system. Equipment, machinery and work procedures should be redesigned to cut down accident rate.

(viii) **Proper Clothing.** The workers should be provided with proper clothing and other protective things such as hand gloves, masks, helmets, safety footwear, etc. while at work. The clothings should serve a dual purpose of providing convenience as well as protection at work. The use of articles made of inflammable material must be prohibited while working on operations that involve risk of fire. Chemicals should be carefully handled.

(ix) **Clean Floors.** There should be no trailing of telephone cables on the floors. Floors, passages and stairs must be kept clear of obstructions.

(x) **Safety Campaign.** Safety programme must be given a wide publicity through posters and hoardings. 'Work Safety' and 'Safely Saves' are illustrations of the slogans which may be displayed at critical points. Safety contests may also be held between the plants as a part of the safety campaign. Plant with lowest accident rate may be given some reward.

### Safety Education

A safety education programme, designed to spread safety consciousness among all including executives, supervisors, and operative employees, is necessary and it must have complete support of top management. Enlisting the co-operation of all in the safety programme is a part of safety promotion. Safety education may be imparted via posters, bulletin boards, houseorgans, displays, cartoons, slogans, signs, and safety films. The employer must not only spend on safety education, but also provide necessary safety equipments and maintain them in good working order.

Every new employee must be given safety training in the first week of his joining and the old employees must also be provided with retraining. The safety office plays a vital role in promoting safety consciousness through safety education and training. T.O. Armstrong has outlined five elements of a safety training programme<sup>5</sup> which are as follows :



1. A safe method of performing each job operation or sequence of operations is developed and described in simple but adequate detail.
2. The various hazard points are brought to light and described together with the relationship between these and the various steps in safety method.
3. The teaching is systematic and thorough. In the somewhat idiomatic English of a successful teacher, it is :
  - (a) Tell him.
  - (b) Show him.
  - (c) Have him do it.
  - (d) Correct him until he has it.
  - (e) Supervise him to see that he keeps it.
4. The reason for requiring the wearing of personal protective equipment needed, if any, as goggles, safety shoes, hand protectors and the like is explained and its proper use and care taught in full detail.
5. Specific safeguards needed for the protection of the worker or his fellows are similarly explained and their correct usage taught.

### **Role of Government**

The Government has set up Factory Advice Service and Labour Institute, Bombay, which functions as an integral body to advise Government, industry and other interests concerned with matters relating to safety, health and welfare of factory workers. It undertakes the enforcement of the laws on safety and health of workers.

The Government has drawn up a "National Programme for Co-ordinated Action Plan" for control of hazards, and protection of occupational health and safety workers in dangerous manufacturing processes. The Action Plan lists out the responsibilities of the Government, management and workers' organisations in the field of safety and health in work environment, and includes 'model scheme for setting up Full Safety Control System Cell' in hazardous industries and 'Safety and Health Accidents Reduction Action Plan' (SAHARA) in all industries.

### **National Safety Council**

The National Safety Council was set up in 1966 to promote safety consciousness among workers to prevent accidents, minimise dangers and mitigate human sufferings, conduct programmes, lectures and conferences and conducts safety, educational information and data. As on 31 March, 1985, the Council's membership of 1,683 consisted of 1,456 corporate members, 141 individual members, 33 trade union members and 53 life members. The National Safety Day is celebrated on 4th March every year throughout the country to mark the foundation day of the National Safety Council.

### **National Safety Awards**

To give recognition to good safety performance on the part of industrial undertakings and to stimulate and maintain the interest of both the



managements and the workers in accident prevention programmes, the Government instituted in 1965 the National Safety Awards. The award schemes were instituted for factories registered under the Factories Act, 1948, but from 1971, separate schemes for factories not covered under the Act and for ports have also been introduced. The National Safety Awards for mines were instituted in 1983.

### HEALTH OF WORKERS IN FACTORIES

Secs 11 to 20 of the Factories Act, 1948 contain provisions regarding creation of healthy working conditions for workers. These are examined below

**1. Cleanliness (Sec. 11).** Every factory shall be kept clean and free from effluvia arising from any drain, privy, or the nuisance, and in particular :

- (a) accumulation of dirt and refuse shall be removed daily by sweeping or by any other effective method from the floors and benches of work rooms and from staircases and passages, and disposed of in a suitable manner ;
- (b) the floor of every workroom shall be cleaned at least once in every week by washing, using disinfectant, where necessary, or by some other effective method ;
- (c) where a floor is liable to become wet in the course of any manufacturing process to such extent as is capable of being drained, effective means of drainage shall be provided and maintained ;
- (d) all inside walls and partitions, all ceilings or tops of rooms and all walls, sides and tops of passages and staircases shall be suitably cleaned, repainted or revarnished periodically.

**2. Disposal of Wastes and Effluents (Sec. 12)** Effective arrangement shall be made in every factory for the treatment of wastes and effluents due to the manufacturing process carried on therein, so as to render them innocuous, and for their disposal.

**3. Ventilation and Temperature (Sec. 13).** Effective and suitable provision shall be made in every factory for securing and maintaining in every workroom :

- (a) adequate ventilation by the circulation of fresh air, and
- (b) such a temperature as will secure to workers therein reasonable conditions of comfort and prevent injury to health, and in particular :
  - (i) walls and roofs shall be of such material and as designed that such temperature shall not be exceeded but kept as low as practicable ;
  - (ii) where the nature of the work carried on in the factory involves, or is likely to involve, the production of excessively high temperature, such adequate measures as are practicable shall be taken to protect the workers therefrom, by separating the process which produces such temperature from the workroom, by insulating the hot parts or other effective means.



**4. Dust and Fume (Sec. 14).** In every factory in which, by reason of the manufacturing process carried on, there is given off any dust or fume or other impurity of such a nature and to such an extent as is likely to be injurious or offensive to the workers employed therein, or any dust in substantial quantities, effective measures shall be taken to prevent its inhalation and accumulation in any workroom, and if any exhaust appliance is necessary for this purpose, it shall be applied as near as possible to the point of origin of dust, fume or other impurity, and such point shall be enclosed so far as possible.

In any factory, no stationary internal combustion engine shall be operated unless the exhaust is conducted into the open air and no other internal combustion engine shall be operated in any room unless effective measures have been taken to prevent such accumulation of fumes therefrom as are likely to be injurious to workers employed in the room.

**5. Artificial Humidification (Sec. 15).** In respect of all factories in which the humidity of the air is artificially increased, the State Government may make rules :

- (a) prescribing standards of humidification ;
- (b) regulating the methods used for artificially increasing the humidity of the air ;
- (c) directing prescribed tests for determining the humidity of the air to be correctly carried out and recorded ;
- (d) prescribing method to be adopted for securing adequate ventilation and cooling of the air in the workrooms.

#### **6. Overcrowding (Sec. 16)**

- 1. No room in any factory shall be overcrowded to an extent injurious to the health of the workers employed therein.
- 2. Without prejudice to the generality of sub-section (1), there shall be in every workroom of a factory in existence on the date of the commencement of this Act at least three hundred fifty cubic feet of space for every worker employed therein; and for the purposes of this sub-section, no account shall be taken of any space which is more than fourteen feet above the level of the floor of the room.

#### **7. Lighting (Sec. 17)**

- 1. In every part of a factory where workers are working or passing, there shall be provided and maintained sufficient and suitable lighting, natural or artificial, or both.
- 2. In every factory, all glazed windows and skylights used for the lighting of the workrooms shall be kept clean on both the inner and outer surfaces.
- 3. In every factory, effective provision shall, so far as is practicable, be made for the prevention of ;
  - (a) glare, either directly from a source of light or by reflection from smooth or polished surface ;



Date: / /

## UNIT - V

### ERGONOMEN MEN AND MACHINES

#### ★ ★ ERGONOMICS :

"It is defined as the study of <sup>the</sup> design of a workplace, equipments, machines, tool, product, environment and system which takes into consideration humane beings physical, physiological, his mechanical and psychological capabilities and optimises the effectiveness and productivity of work system while assuring the safety, health and well being of the workers" ACCORDING TO FERNANDEZ AND MARLEY

In general, the goal of ergonomics is to fit the task to the individual not the individual to the task. Ergonomics is the science of designing the work station to fit within the capabilities and limitations of the workers.

The goal of office ergonomics is to design your office workstation so that it fits and allows for a comfortable working environment for maximum productivity and efficiency.

Ergonomics is the process of designing or arranging workplace, product and system so that they fit the people who use



there. Ergonomics applies to the design of anything that involves people work spaces, sports and leisure and safety in

Ergonomics The branch of science that aims to learn about human abilities and limitations and then apply this learning to improve people's interaction with product systems and environment.

Ergonomics aims to improve work spaces and environment to minimise risk of injury or harm. So as Technology change so too does the need to ensure that the tools we access for work, rest and play designed for our body requirements

### \* BENEFITS AND IMPORTANCE OF WORKPLACE ERGONOMICS:

1. Ergonomics reduce cost.
2. Ergonomics improves the productivity:

The best ergonomics solution will often improve productivity by designing a job allow for good posture less exertion, fewer motions and the movement, better heights and reaches and the work station becomes more efficient.

3. Ergonomics improve quality: Poor ergonomics leads to frustration



and fatigue workers that don't do their best work and where the job task is too physically taxing on the workers. They may not perform their job like they were trained.

For an example: An employee might not fasten a screw tight enough due to high force requirements which could create a product quality issue.

#### 4. Ergonomics improves employee engagement.

Employees notice when the company is putting their best efforts to insure their health and safety. If an employee does not experience fatigue or discomfort during the work day, it can reduce turnover, decrease absenteeism, improve morale and increase employee involvement.

#### 5. Ergonomics creates a better safety culture.

Ergonomics shows your company commitment to safety and health and adds more value. The cumulative effect of the previous 4 benefits of the ergonomics is stronger safety culture for any company. Healthy employees are most valuable assets, creating or fostering the safety and health



culture at any company will lead to better human performance for organization.

#### \* PRINCIPLES OF ERGONOMICS :

1. Reduce excessive force
2. Keep things easy to reach
3. Work in plane or comfort zone
4. Reduce excessive motion
5. Reduce static load
6. Minimise pressure points
7. Provide clearance
8. Enable movement in stretching
9. Reduce Excessive vibrations
10. Provide good lighting conditions
11. Neutral postures

#### \* EXAMPLES OF ERGONOMICS

1. Chair is too low for desk
2. Upward sloping keyboard
3. Use of laptop as a full desktop replacement
4. Sitting for too long

I Ergonomics reduces cost: By systematically reducing ergonomic risk factors, you can prevent costly MSD's. With approximately \$1 out of every \$15 in work comp cost attributed to MSD's, this represents an opportunity for significant cost savings. And Indirect costs can be up to twenty times the direct cost of an injury.