Work System Design
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Lecture-52
Industrial Ergonomics

Namaskar friends. Welcome to session 52 and this is a second session on the topic Ergonomics and in the last session we have started the discussion for the 11th Week. We have already finished 10 weeks of discussion and in the 10th week our focus was on work measurement and in the 11th week our focus is on Ergonomics. So if we just have a brief overview of what we have covered we know that how to develop a better or a best method for doing the work.

We know how to find out the time required or the time to be taken for performing the work using the standard method which has been found out after method study. So now we are trying to work on the interaction between the man and the various system, elements or the elements of the system in such a way that the overall system performance is good as well as the human comfort is taken into account.

So when we talk of the human comfort there are so many things that come to our mind. It is for me as a teacher it is easier to speak for half an hour or one hour or 2 hours in a day. But if I have to speak for 8 hours in a day definitely my vocal cords need to be strengthened. If I am speaking for 8 hours, 10 hours in a day I need to do some exercise for my vocal cords. For example, if a player is playing or he is into sports he needs to take care of his muscles.

He needs to take care of his bones, he need to take care of his weight. So the point is that when we are doing the things repetitively again and again over and over again thousands of time in a day we need to take care of the body parts or of the muscles, tendons, ligaments which are getting involved in the repetitive work over and over again many times in a day, numerous times in a day then that is important.

And if you see the workers who are performing the same task again and again somebody is involved in an assembly operation. So his task is to assemble maybe the most simplest example we can take nut and bolts or he is on the assembly line he has to fasten nut and bolt

in the system maybe hundreds of times in a day. So his body is moving in a similar fashion again and again maybe his shoulder, his elbow, his wrist, his hand is doing the same movement maybe thousands of time in a day.

So in those cases because of this repetitive type of work there are problem area. So the comfort of the worker is not assured if he is doing the same task again and again, over and over again. So therefore as an industrial engineer it is also our duty to design the work in such a way that such type of repetitive strain injuries or the injuries which we usually called as the musculoskeletal disorders are avoided.

So Industrial Ergonomics focus on all these aspects and try to identify areas where such type of injuries can occur, how to identify them, what are the symptoms and how to eliminate them, how to take over them, how to control them so that is basically the idea with which we have planned the today's session on Industrial Ergonomics. So we may take an example or 2 and if you see that now our target is to study Ergonomics only till the end of our subject.

So we are going to focus on various case studies at a later stage, but before we go to those case studies. I think we believe that we must be able to completely comprehend that what is the basic purpose of studying this subject of Ergonomics and nothing better than studying that what are the ill effects if we do not follow the principles and guidelines or theories and principles of Ergonomics.

So if we do not keep all these things in mind what it is going to lead to that is very, very important to understand and that is the purpose with which we have planned the today's session. We will see that in industry what type of injuries may happen to the worker who are continuously involved in doing the same work over and over again. Now let us try to see first the Industrial Ergonomics this is some example.

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Now here you can see Industrial Ergonomics we will try to understand what it is and why should it concern me. Now here you can see a person is shown with a back pain and this is one scenario which is shown in which lot of noise is being generated through this system. So maybe this is example of work environment or the conditions this is one example of working conditions which are not congenial or advisable.

This is related to one word which we have seen in our previous session physical ergonomics the physical work is being done by the person and he is having a feeling of discomfort. So all this has to avoided. How you can avoid it that needs to be seen, that needs to be understood, that needs to be practiced and therefore ergonomics is a multidisciplinary concept. We must have knowledge information related to engineering.

We must have knowledge information related to the anthropometric Data. We must have psychological information, physiological information. So when we have knowledge of all these aspects we must also have knowledge about the various rules, regulations (()) (06:33) ordinances factory act which govern the kind of conditions that has to be necessarily provided to the workers when they are working on the shop floor.

So it is a multidisciplinary concept and if we take into account all these important points or constituents of ergonomics we will definitely be able to design a system in such a way that the worker will be able to perform his task in the most easiest manner as well as it will not cause any injuries or harm or the environment will be safe for him to work for the organization or to work for meeting the objective of the organization.

So these are just 2 examples there can be hundreds of such example which will indicate that these conditions can be improved.

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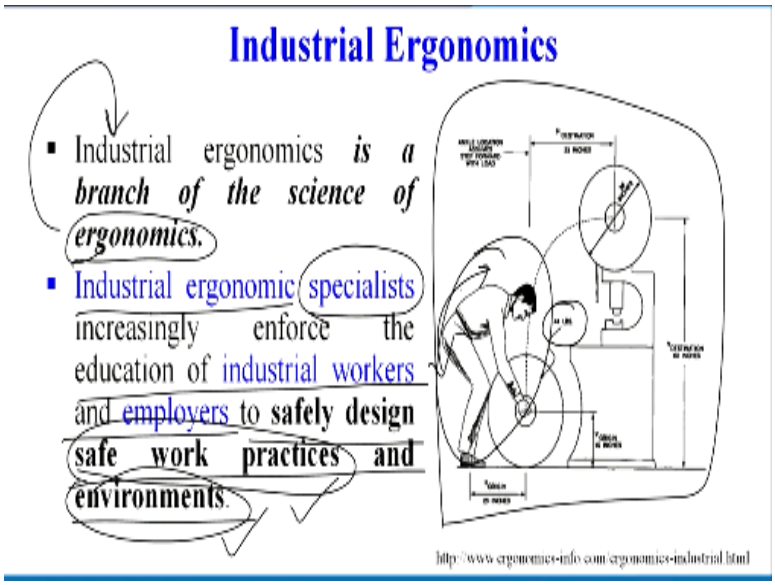

Now Industrial Ergonomics is a branch of science of Ergonomics. Ergonomics is a broader concept. An Industrial Ergonomics is a bit specific concept and if you remember in the previous session when we were understanding the basic concept of Ergonomics I have told that ergonomics is not only related to the shop floor, it is related to the universal activities or the universal work that is being done.

I am recording this session so here also the concept of Ergonomics holds good. The recording assistance or the managers are recording the lecture they are also operating one equipment. So that work that they are doing, controlling the equipment is also equally relevant to the concept of Ergonomics or vice-versa ergonomics is equally relevant to the persons operating the equipment for recording this lecture.

So wherever we go we have taken an example of bus driver driving a bus there also the concept of Ergonomics holds good. So here also industrial ergonomics is more or less specific to the industrial shop floors. So Industrial Ergonomics specialist people who specialize in Industrial Ergonomics increasingly and force the education of industrial workers and employers to safety design and safe work practices and environment.

So in the previous slide you have seen that lot of sound was being generated so it is not a safe

environment. Safe work practices have to be ensured for example if you visit any organization where there is a chance or there is a probability of some heavy objects falling from the top you will always be advised to wear a helmet special kind of shoes will be given when you visit an industry.

So those are safe practices. Safe environment has to be ensured as well as special training of the workers and the employers is an important domain under the Industrial Ergonomics. Here we can see this is one example here. A worker involved in doing this physical work. So this you can see this person the weight of the job is also given he is lifting it and then he is taking it to a height.

So that you can say that we can design this system or with the help of certain assistive devices we can ensure that his back does not bend over and over again. So here if the person has to bend maybe hundreds of time in a day definitely he may have some problem over the years. I may not say that over a period of one week or 2 weeks he will start having a problem, but over a period of years he may develop some back problem.

If he is lifting heavy load many times a day even if you see the weight lifters these days' common wealth games are going on. You see the lifters when they lift the load they use a specific type of belt. So they may be lifting the loads maybe number of times during their practice session. So there is a chance or probability of a back injury and in order to prevent that they use a belt which protects them from the back injury.

So that is one safe working practice that whenever you were doing some work whatever are the safety guidelines you must ensure. Similarly, another example from sports I will take most of us follow cricket. In cricket the batsman always wears a helmet. People who play squash they always are advised to wear the goggles before they enter into a squash court. So different safety devices are there which needs to be taken into account.

So when we are talking about the shop floor whatever safety has to be taken into account or whatever safety guidelines are there, safety devices are there, safety equipment is there we must ensure that it is being utilized. For example, as I am a mechanical engineer if you are welding we must always use the mask. So without mask we must avoid the welding. So these are few examples of Industrial Ergonomics.

So there are 3 things first is the training, second is the safety or design of the system in such a way that is safe then we must follow the safe practices as well as the environment that we are providing to the workers must be safe or occupational hazards must be minimized to a minimum level.

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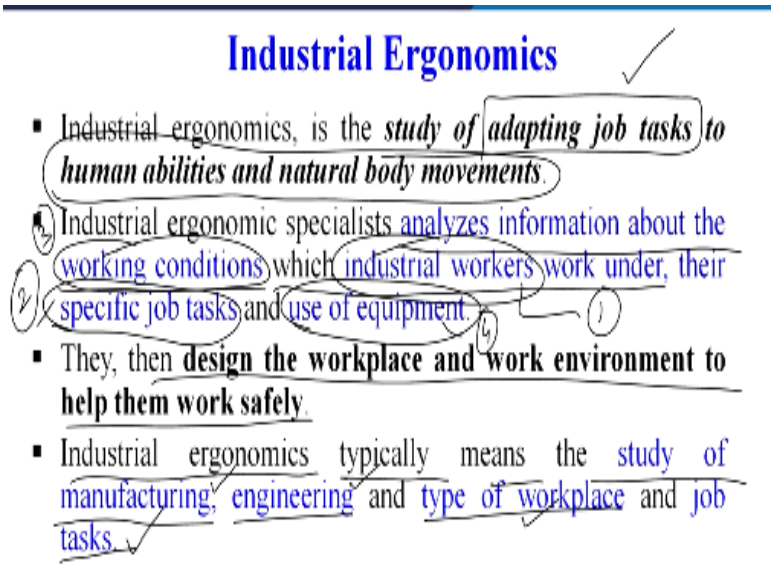

So Industrial Ergonomics is a study of adapting the job tasks to the human abilities and natural body movements. So we have to adapt the job task as per the human abilities and natural body movements. Sometimes we may have to force our body to do a particular work. So those forced body movements must be avoided. Natural body movements must be taken into account.

So Industrial Ergonomics is a study which will try to help us to design the work or to adapt the job task in such a way that the human capabilities are optimized as well as the natural body movements are utilized. Industrial Ergonomics specialists, so specialists who are maybe experts in the area of Industrial Ergonomics analysis the information about the working conditions which industrial worker work under.

So the industrial worker is working under certain working conditions so they will try to analyze that and then they try to analyze their specific job task also as well as the use of equipment. So basically you can see all the various elements of the system are taken into account. Let us see one by one as far as a teacher I feel that industrial workers can be given first priority then the specific jobs that they are doing.

The working conditions under which they are doing the job and the equipment that they are using. So the various elements of the work system are taken into account by the ergonomist who specialize in Industrial Ergonomics and then they try to interface or try to study the interface between the various elements and try to design a system which is not only beneficial from the worker point of view, but is also beneficial from the organization point of view.

Because in the previous session we have highlighted that the system performance must not suffer. We have to ensure the system performance at the same time we have to ensure the human efficiency also. So then they design the workplace and work environment to help them work safely. So they try to focus on the workers or the industrial worker and try to design the work system or workplace in such a way that the workers feel comfortable, they do not feel tired, they do not feel stressed out, they do not feel fatigued out.

So they feel comfortable while working for the organization. So that is the sole objective of the Industrial Ergonomists to ensure that the workers feel safe, confident as well as they feel themselves associated with the organization because the organization has taken care of their interest. So organization has taken care of all their concerns. So a person is concerned about his productivity, his efficiency, his safety he must not get injured.

So if the organization is able to provide him a workplace or a work system in which he feels comfortable as well as he is able to deliver the kind of work which has been assigned to him he will feel associated with the organization and if the worker feels associated with the organization his productivity, efficiency and effectiveness will definitely be better or definitely be the best.

So Industrial Ergonomics typically means the study of manufacturing. So the Industrial Ergonomics typically means the study of manufacturing, engineering and type of workplace and job task. So this is again within Industrial Ergonomics also it is multidisciplinary we must have the knowledge of manufacturing, engineering, type of workplace as well as the job tasks.

Now we have to design the interaction between the job task, the type of workplace as well as the worker who is performing the task, how by using our knowledge of manufacturing and

engineering.

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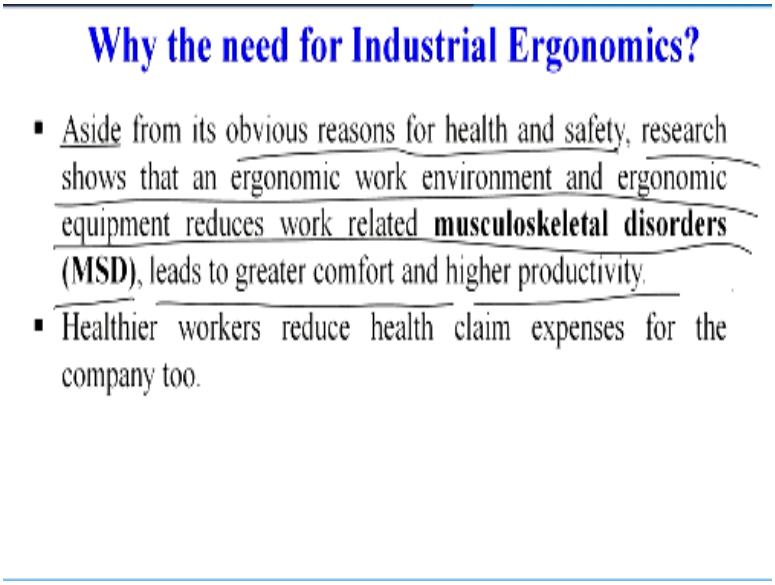

Why the need of Industrial Ergonomics? Now let us come to the core area which we want to address today. So aside from or in addition to the obvious reasons for health and safety. Research shows that an ergonomic work environment and ergonomic equipment reduces work related musculoskeletal disorders which leads to greater comfort and higher productivity. So basically we can see that if the musculoskeletal disorders can be controlled or can be minimized and we must focus as engineer on completely eliminating them.

So if we are completely able to eliminate the MSD it will lead to greater comfort and higher productivity. So apart from the obvious reasons for health and safety research shows that an ergonomic work environment and ergonomic equipment reduces work related musculoskeletal disorder and this equipments leads to greater comfort and higher productivity.

So we must try to design our equipment, our workplace, our work system according to the principles of ergonomics so that our productivity is improved. Our musculoskeletal disorders to the workers are reduced as well as the worker feel comfortable while performing their task. So healthier workers reduce health claim expenses for the company. Suppose a person get injured while performing the task because he was working in an awkward posture.

So in that case the company may have to bear for the medical expenses for the workers as well as may have to help him with the insurance also. So if we are able to design the system

in such a way that the worker is not injured or the probability of the worker getting injured is minimized. It will definitely reduce the insurance expenses for the company. How it can be done that we can train the worker that you are not required to perform in any awkward position.

You have to perform your work using the natural rhythm of the various body parts. So awkward positions if we train the worker that you have to avoid this awkward positions automatically the medical expenses will definitely come down. And I must address here that we are not talking about one single worker in an organization, bigger organizations may have hundreds and thousands of workers working for them.

So for training of each of these workers it is important that we teach them the safe practices in such a way that they adhere to, they comply with the safe practices and they reduce the medical compensation expenditure of the organization.

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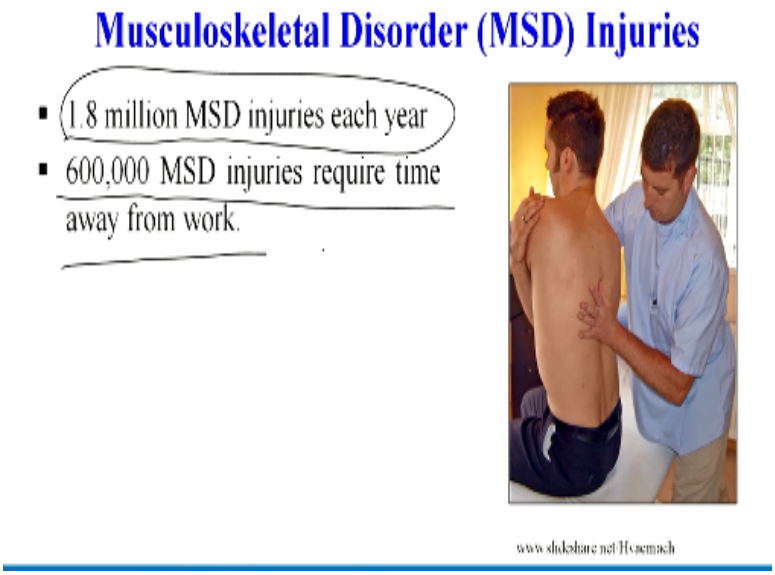

Now let us come to the musculoskeletal disorders. Just some data 1.8 million MSD injuries each year. 600,000 MSD injuries require time away from work. So this data can be found out on the internet also. So this is just to show the extent of MSDs that the companies are encountering.

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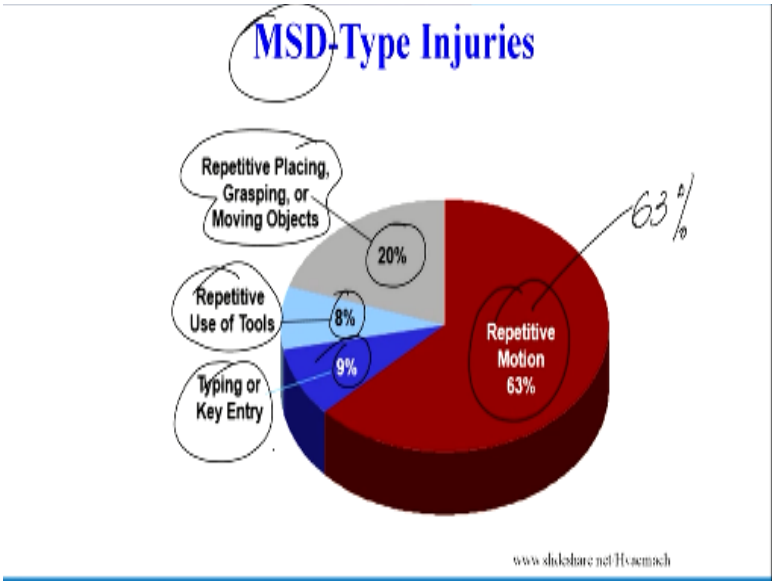

Now this is another thing MSD type of injuries within MSD also musculoskeletal disorder further sub classification, repetitive motion is leading to you can see on the screen 60% of the injuries or the musculoskeletal disorders. Then repetitive placing, grasping and moving objects is leading to 20% of the injuries. So repetitive motion is 63%, repetitive placing, grasping or moving objects 20%,

Repetitive use of tools is leading to 8% and typing or key entry is leading to 9%. So we can see the further distribution amongst the MSD that what are the various types of causes that are leading to MSD and the word repetitive is coming again and again. So mostly we will see that wherever the worker is performing the same task over and over again, hour after hour, week after week and month after month.

There are chances that he may develop this type of problem. And as an Industrial Ergonomist or as a industrial engineer we must try to see that how to avoid such type of injuries. Now what can be done maybe I think this lecture is becoming too negative that these type of problem may occur so we cannot stop working we have to work. So then once we have to work we have to look that how to design the system, that such type of injuries does not take place.

For example, now we have taken in the physical ergonomics there was a worker working on a computer system. So there are guidelines that the distance between the eyes to the screen must be this much. The distance between the elbow, the height of the elbow, the place where you are keeping the keyboard, the place where you are positioning your mouse even the

design of the mouse.

The profile of the mouse, the arrangement of the keyboard, the height at which the keyboard has to be lifted, the angle of the screen that you have to adjust. So there are so many parameters if we look into account of a worker who is working on a computer in his or her office. So if we are able to optimize, if we are able to find out that what is the exact combination of all these values, all this data which is going to mitigate the effect of this repetition of work being done by the worker.

We will be able to design the system in such a way that the worker will feel comfortable even after sitting in front of the computer or working on the computer system for 6 to 8 hours at a stretch. So that is basically the concept of Ergonomics that how to design this system in which the worker feels comfortable and this repetition is definitely going to be there and some of the engineers do propose that wherever lot of repetitive work is there.

We must take away the manual intervention there and we must put in the robotic intervention. So maybe they suggest that instead of manually doing the repetitive work again and again we can change the work system in such a way that robotics intervention is doing the work which is much more precise and accurate as compared to the human being who may feel tired after doing the work for specific period of time.

So there are different theories that in case of repetitive work how to take advantage of the technology, but another point that we must keep in mind is that the robotic intervention involves lot of infrastructural expenditure also. So it leads to lot of additional expenditure in terms of fixed cost. So wherever we can find out or we can kind of justify the manual work in that case the system has to be designed in such a way that the manual work is equally competent as compared to the machine work.

So that is the basic concept with which the ergonomist usually works, ergonomist usually set their objectives. So we can see different types. Now what are the characteristics of MSD, so the last point that I addressed was that how to avoid these MSDs and one can be by the use of technologies.

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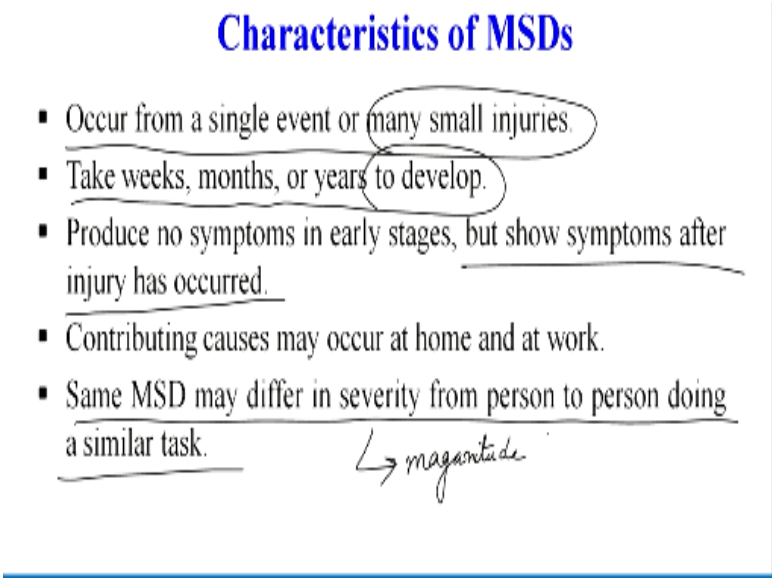

Now what are the characteristics of MSD? They occur from a single event or many small injuries. So many small injuries may lead to MSD take weeks, months or years to develop. So maybe MSDs may not be a single day injury that you encounter, but they may take different time durations to develop, produces no symptoms in early stages, but show symptoms after injury has occurred.

So initially you may not be able to find out that you are suffering from MSD, but later on when the symptoms you start showing the symptoms you will realize that because of the repetitive work that you have being doing or because of small pain that you had for some time for during your working hours that pain has now led to an injury.

Now contributing causes may occur at home as well as at work. So if you are habitual of sitting in an awkward posture both at home and work so these may lead to a kind of a MSD same as MSD may differ in severity from person to person doing a similar task. So each one of us may not develop the same effects of musculoskeletal disorders. So if we are doing the same task also we may develop different magnitude of the MSDs.

So magnitude word I have used in place of severity. The same MSD may differ in severity from person-to-person doing the similar task.

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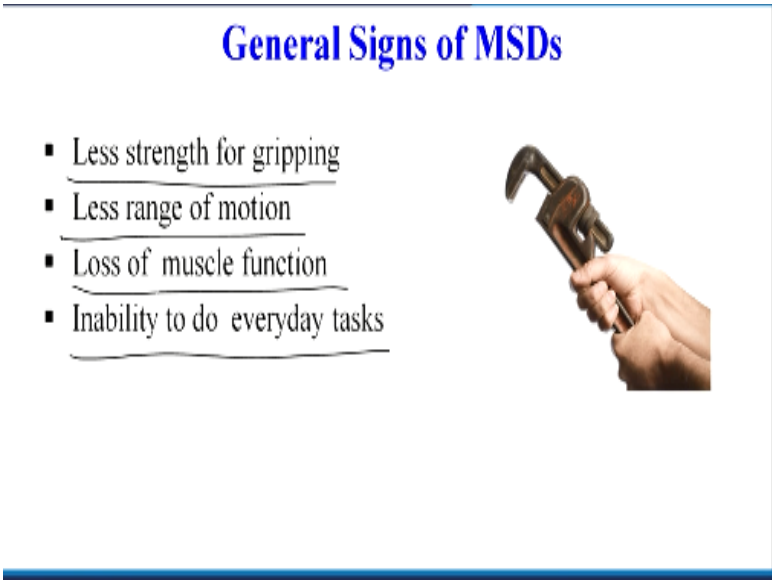

What are the general signs of MSDs? You can see less strength of gripping; you are not able to grip the things properly. It means the ligaments have some problem, less range of motion, loss of muscle function, inability to do everyday task. So if there is a loss of muscle function also maybe you are trying to lift something you are not able to a body is not responding or you are not able to lift the job at hand the work that has been assigned to you that can be one sign of one symptom of MSD.

Now once we are able to identify that musculoskeletal disorder are going to be there or have already happened injuries are being reported how we can mitigate the effects.

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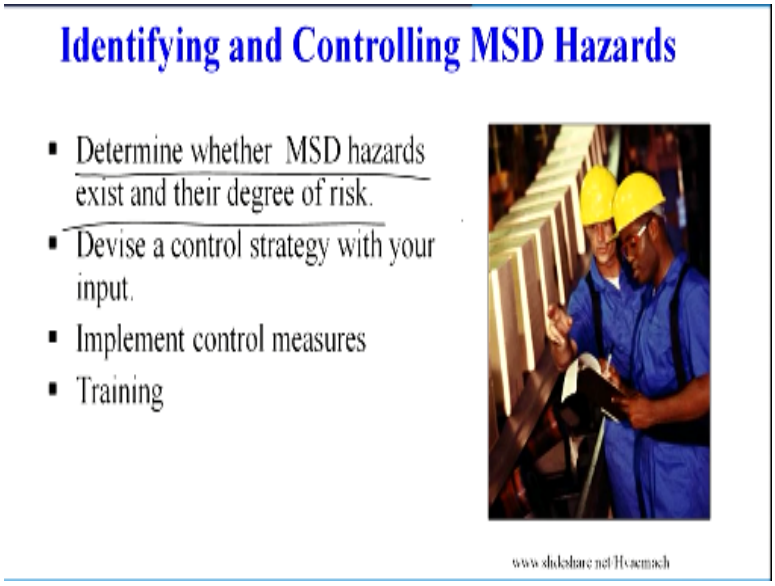

So identifying and controlling the MSD Hazards. Determine whether MSD hazards exist and their degree of risk so degree of risk we can see, we can consult the experts, the doctors, the

physiotherapist and try to ascertain that how much is the effect. Devise a control strategy with your input, implement the control measures and then train the workers about the right ways of doing the work such that such injuries do not reoccur.

Now what can be the control methods, we can see quickly what can be the control methods here. So once we are able to find out some of the workers in the organization have reported that they are suffering from maybe suppose the backache which can be one reason for nonperformance or they have some problems with their ligaments or tendons.

So in those cases we may consult a physiotherapist or maybe a specialist doctor who can advise us that such type of exercises can be advised to the workers which can help them to recuperate to come back their muscles can gain the strength again. Some kind of medication may also be advised.

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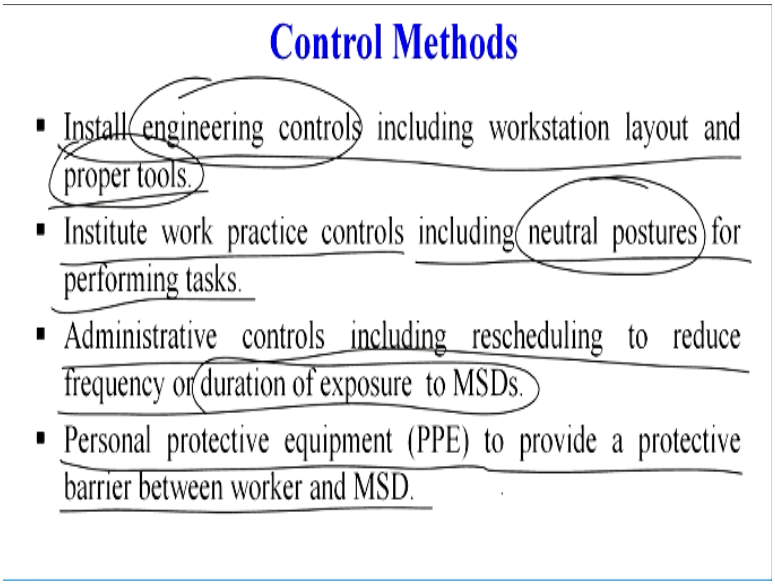

So what are the control methods once we have identified that because of the repetitive work some of the workers have developed the MSDs, how we can control those MSD let us try to look at those. So we can install the engineering controls including workstation layout and proper tools an engineering solution to the MSDs. Institute work practice controls including neutral postures for performing task.

So this is one of the important points that we must emphasize on neutral posture when they perform the task. We must install engineering controls which is including workstation layout and proper tools. So we have an engineering solution, we have a anatomy based solution or

maybe the body based solution, administrative control including rescheduling to reduce frequency or duration of exposure to MSD.

So there are important words like job rotation, job specialization job simplification. So as an administrator or as a work manager we can try to reschedule the work the person is doing so that effect of prolonged exposures to a particular type of work which may lead to a specific damage to a specific muscle that can be avoided if we keep on switching the work being done by the various workers, personal protective equipment to provide a protective barrier between worker and the MSD.

One example just I have taken may not be that relevant that when a weight lifter lifts the load he always uses a belt can be one example which is roughly related to this point.

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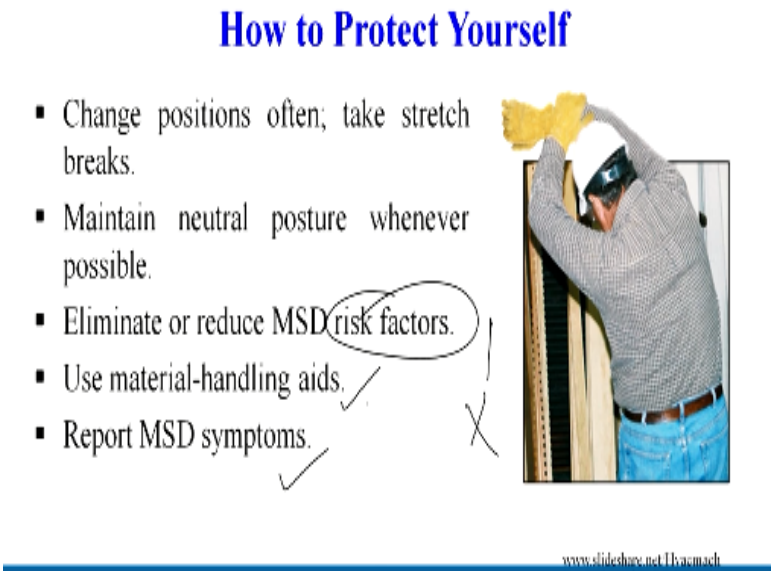

And change the position often takes stretch break. So if we are sitting for long hours in front of a system or a computer system you must get up and walk down a bit and do some stretching exercises. Maintain a neutral posture whenever possible. Eliminate or reduce MSD of risk factors so whatever risk factors have been identified this must be tried to or we must try to eliminate those. Use material-handling aids, report the MSD symptoms.

So whenever we find some specific pain in specific body part which we are using continuously for performing our task day in and day out we must report that symptoms so that the corrective action can thereby be taken care of. So with this, we conclude the today's session and the next session we will carry forward our discussion related to the concept of

Ergonomics. Thank you.