Applied Ergonomics
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Lecture – 23

So, welcome to this lecture. So far we have started physical work environment and in this lecture we would cover lighting system, auditory environment and effect of noise. So, as we are aware that ergonomic objective is to provide the proper environment and as well as the proper amount of light in your surrounding in order to perform any particular task. So, we have to consider several lighting and designing criteria.

So, in series with that we will learn that what are the lighting design consideration.

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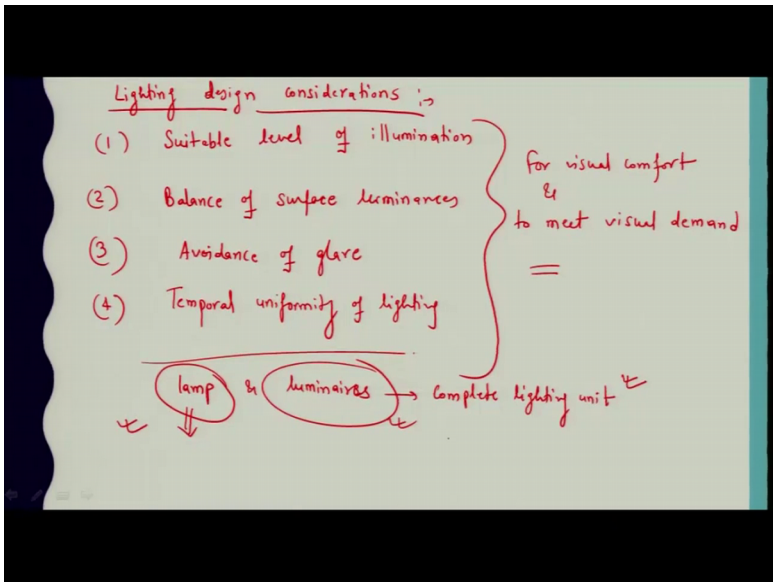

So, as for as our visual comfort is concerned, we have to consider following points. The first point is workplace it should have suitable level of illumination and balance of surface, luminescence. The third point that should be considered while designing a lighting system in a workspace is avoidance of glare. The forth point which may be considered as a temporal uniformity of lighting.

So, these all the points should be considered for visual comfort as well as to meet visual demands in a particular work space. So, that ergonomic objective is accomplished by designing an appropriate lighting system one that gives sufficient, but not too much light for task at hand, so there are 2 terms of interest which we need to understand the first is lamp and second is luminous. This particular lamp is a obviously, it may be a natural, if you are working in the sunlight or it can be it is mostly basically a single artificial source of light. This luminous is a complete lighting unit, it may include one or more lamps reflectors and other piece of operators to distribute the light and amines to connect it to the power supply. So, here we will be discussing about the lighting system first.

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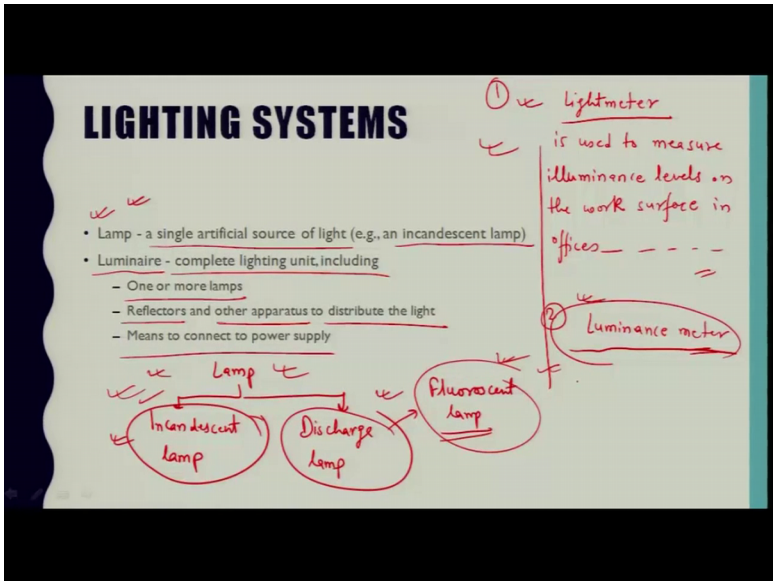

So, in that this lamp is defined as the single artificial source of light. Example in candescent lamp, luminaire has a complete lighting unit which includes one or more lamps reflectors and other apparatus to distribute the light and means to connect to the power supply. So, one thing that one needs to keep in mind that ergonomist are not any illumination engineer, but they should be able to use a light meter. So, there is a light meter there is a one basically you can say it is a tool for ergonomic assessment in terms of checking the visual intensity. So, this particular light meter is used to measure illuminance level. This light meter is used to measure illuminance levels on the work surface in, let us say officers, shops, factories etcetera and the reading can be compared with the levels recommended in some standards.

So, there is some basic steps and carrying out lighting survey for ergonomic purpose also. So, one another tool which is also available in order to check the lighting system or light intensity, that is luminance meter, is particular luminesce meter is commercially available. So, they look a little like video cameras and give the luminous of small region of any surface they are directed that. So, this luminous meter is probably not necessary for basic ergonomic lighting surveys; however, this retinal adaptation of an defense or luminance of objects in the visual field. So, this was all about the tools that is used in this field basically. And now we need to understand as a next step is what are the types luminous existing. So, before that I need to clarify about the lamp and the various basic types of lamp. So, here I am initiating this particular topic here.

So, as for as definition of lamp and luminaire is concerned, it is given here and now this lamp can be classified into 2 basic types. First is incandescent lamp and second is discharge lamp. This particular incandescent lamp operate by electrically heating filament that you that in the houses this particular incandescent lamp is frequently used. So, it is basically operated by electrically heating of filament that produces radiant energy must somehow switches in our visible spectrum.

So, the common material for this filament is tungsten and this particular discharge lamp it produces light by means of an electric discharge in gas. So, this particular discharge lamp are generally more complicated, because they require special controls to provide the conditions under which discharge is initiated and sustained. So, the most common discharge lamp is fluorescent lamp. That is usually in the form of glass tube who is the inner surface is coated with the fluorescent material. And which contains mercury vapors whose bombardment by electrons causes light emission.

So, the following this category of lamp there are several characteristics of about lamp also which is very important to know in terms of lighting design, which are I am going to list down those characteristics of the lamp.

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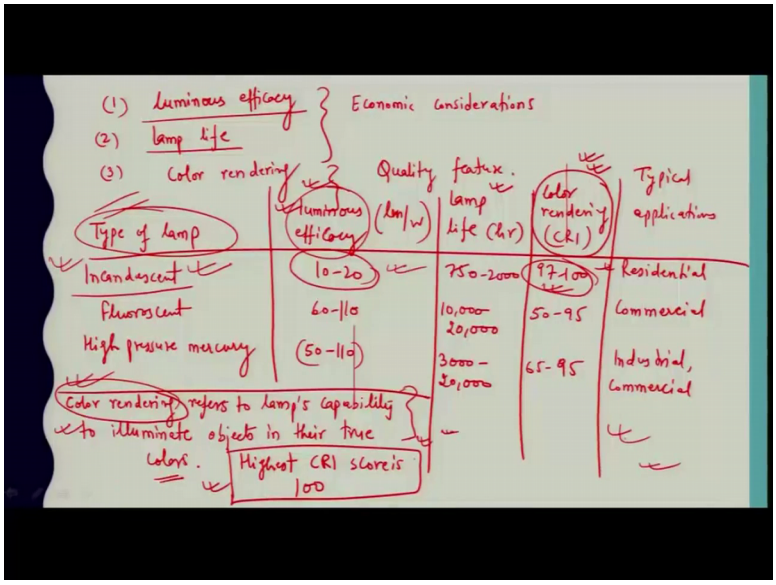

So, here the first characteristic that lamp should have and that is luminous efficacy, let us say and second is lamp life third is color rendering. So, this luminous efficacy and lamp life are economic consideration. And this colour rendering is a quality feature. So, the typical values of these characteristics for various types of lamps along with the common application, I am trying to list out here. So, if let us say the type of lamp the luminous efficiency, lamp life this colour rendering and typical application.

So, here if we use incandescent, the filament is made up of tungsten here. So, it is luminous efficiency basically that can be expressed as a lumen. So, it could be 10 to 20 lamp life will be if it is expressed in hours 750 to 2000 and colour rendering that is expressed as a CRI that is 97 to 100. And it is generally for residential purpose, it has been used as far as fluorescent lamp is concerned it is luminous efficacy is 60 to 1 1 0. And it is lamp life is near about 10,000 to 20,000 hour. And it is colour rendering is 50 to let us say 95. And it is used for commercial purposes and high pressure mercury lamp.

So, it is luminous efficacy is at one 50 to 1 1 0 and it is lamp life is 3000 to 20000. And it is a colour rendering is from 65 to 95 and it is used for industrial as well as for commercial purposes. So, this is the characteristic of a selected lamp types. And so this particular basically this luminous efficacy. This luminous efficacy refers to the efficiency of lamp. So, that is it is capacity to convert electrical power to luminous power. So, this particular luminous efficacy is measured in lumens per watt. This particular lamp life is how long the type of lamp is expected to last and that is expressed in hours. And like

there are variation in trade off within a given type. For example, long life incandescent bulb last longer than a conventional incandescent bulb.

So, but it is light output that is in lumen is lower during that life. And now you will be questioning about what is that colour, red colour rendering which I have written here. So, this particular colour rendering it is referring to the lamps capability to eliminate object in their true colour. So in fact, writing here as a sentence as well that this colour rendering is what. So, it refers to lamps the capability of lamp to eliminate objects in their true colors. So, the lamp types varying in this capability say though. So, the issue is important for task in which colour must be, that colour must be identified or compared for some purpose. So, far that case the true colour identification is very much important in any let us say in any workstations.

So, this how would you measure this colour rendering. So, there is a index decided for that. So, that index is CRI that is colour rendering index. So, this particular CRI is most widely used measure for colour rendering. And the highest colour rendering index score is hundred which is obtained in daylight. So, in delight you will be able to identify the true colour of any object. So, in that particular case when daylight is used for visualization purpose. Then highest CRI will be hundred. So, as the CRI score of a given lamp type decreases. So, this indicates a reduction in the lamps colour rendering capability. Unfortunately, there is some work of a negative correlation between CRI. And luminous efficacy and incandescent lamp gives very good colour rendering that is up to 97 to 100.

But it is efficacy or efficiency is very poor as you can see from this particular table. So, incandescent table will give you the true colour, but it is efficiency is very much low. So, this is some somewhat of estimation that has been done and I have put for your knowledge.

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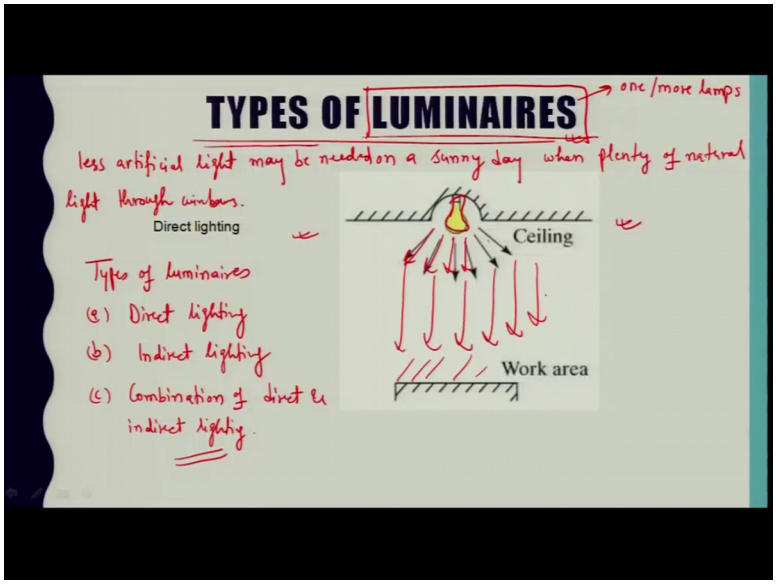

So, now we need to understand what is luminaires. So, this particular luminaire as by definition, we have understood this luminaire particularly consist of one or more lamps. That is together with the other hardware component, which is required to accomplish a complete lighting unit multiple luminaires are usually required to make a complete lighting system for a room in a facility. So, modern lighting system of an includes controls to alter the lighting levels depending on the time of day and function of room.

So, like when less artificial light may be needed on a sunny day, when there is a plenty of natural light when let us say plenty of natural light is there, through windows. So, as far as the types of luminaires are concerned. So, the types of luminaires maybe a direct lighting indirect lighting or combination of direct and indirect lighting luminous can be classified according to the proportion of the light that are emitted above or below the friction itself. So, 3 major categories can be illustrated. So, one of the figure that has been put for you to understand about the type of luminaires. So, here you can see that the bulb is giving the light to the work area and this is the example for direct lighting as you see this figure this particular example is for showing the indirect lighting phenomena.

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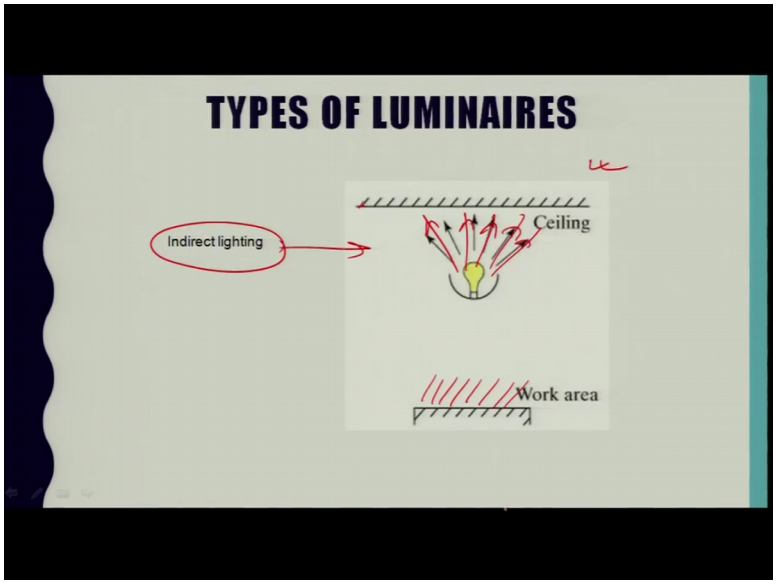

So, the bulb is in this direction and it is lighting direction is towards the ceiling, but still it is giving some light to the work area.

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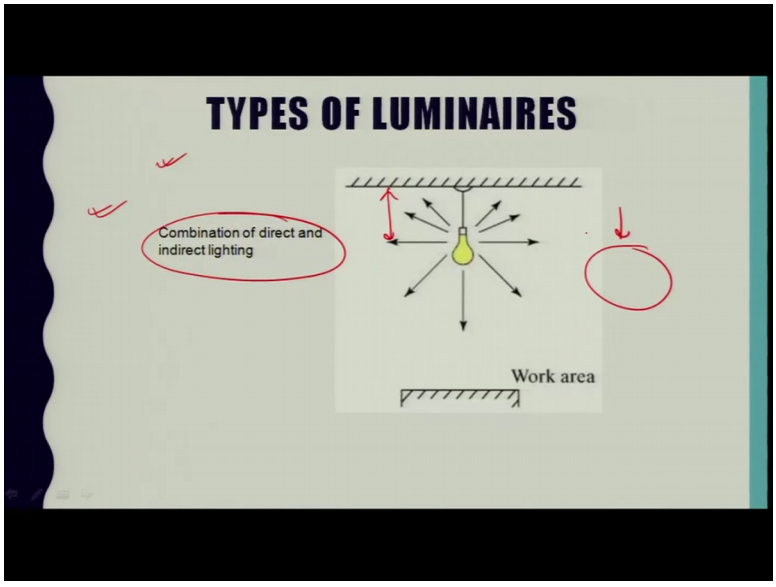

So, this is example of indirect lighting and here this particular is a combination of direct and indirect lighting. So, where it is at some distance and it is illuminating the working area. So, in all the cases like a direct lighting shines down ward providing high direct illumination of the work area. And however, glare may be a problem indirect lighting shines on the ceiling here because the ceiling is usually a colour with high a reflectance. So, the most of the light is reflected downward and diffused to reduce glare.

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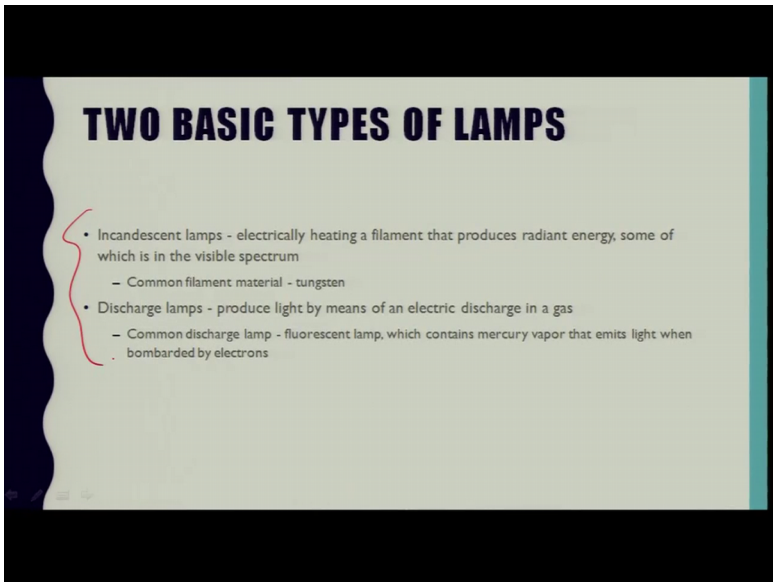

So, in this way this things have been covered. So, as a summary of what we have learnt in previous slide. So, there are 2 basic types of lamps incandescent lamp and discharge lamp. So, now, another topic that we are going to cover that is auditory environment and the effect of auditory environment to the system performance, which is very much essential as far as ergonomic area is concerned.

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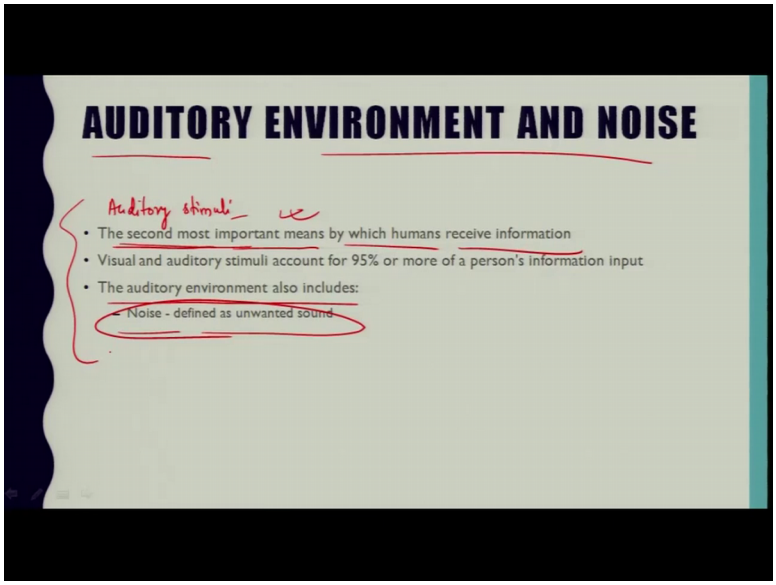

So, the auditory environment and noise. So, in that this particular auditory is the second most important means by which human receive information. So, as we know and we are

aware of the fact that visual and auditory stimuli both in a combination give the 95 percent or more of a person's information input. And this auditory environment also include which defined as the which is defined as the unwanted sound. So, this particular auditory stimuli we can say is the second most important means by which we perceive the formation. And so apart from this understanding of this noise and auditory stimuli. So, we will now try to understand what are the possible effect of noise on humans. So, now, effect of noise we will try to understand.

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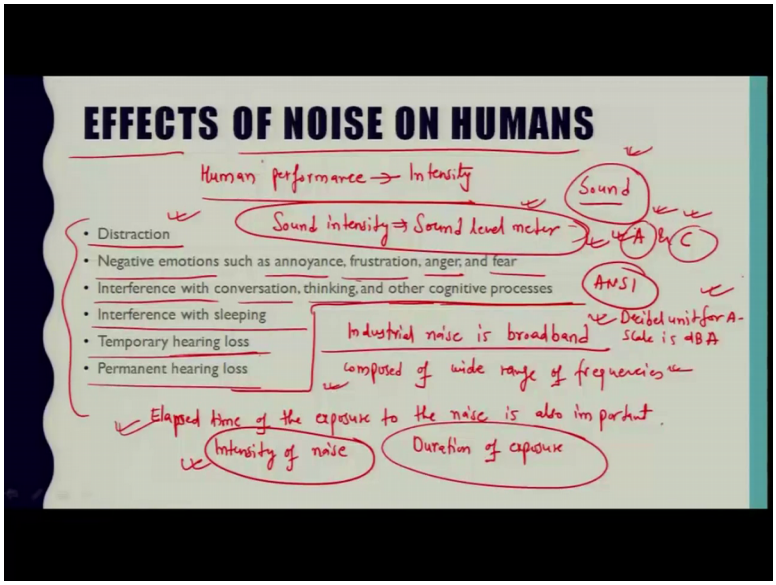

So, the possible effects of noise on human being are both are both physiological and psychological. So, the effect may include the distraction from work which were doing from let us say pro long period of time. So, sudden noise level increment will give you the distraction and deviation from your work. Negative emotions such as an annoyance frustration anger and fear interference with conversation thinking and other cognitive process interference with sleeping temporary hearing loss and permanent hearing loss.

So, these are the possible adverse effect if the noise level access the permissible limit of a workspace where or workstation where you are performing your task. So, as far as noise factors that affects human. So, there are basically in the sound noise is basically sound which is unwanted for a human being. So, sound is characterized by 2 attributes that is frequency and it is pitch. So, the though physical attributes of sound.

As that frequency which is perceived by the listener as pitch and intensity and which is perceived as a loudness. So, the noise is characterized by same attribute in assessing the potentially negative effects of noise on human performance intensity is more important of too. So, human performance is directly related to sound intensity. Like it is not directly related it is not in the sense of directly proportion, but it is in a relation with intensity of the sound. So, industrial noise is usually broadband. So as far as industrial noise is concerned. So, is broadband the meaning of which is it is composed of wide range of frequencies. So, the importance of frequency is reduced. So, in addition in addition to this intensity, the elapsed time of exposure elapsed time of the exposer to the noise is also important.

So, increase the duration of exposure to a lot to loud noise increases the risk of hearing damage. Thus we have 2 factors that are of primary concern in assessing the effect of the noise on the human worker. So, the first is intensity of noise that we need to take care. And second is duration of exposure to the noise source. In fact, that intensity and duration of exposure both can be measured with that with the equipment that has been developed. So, in case of continuous noise of constant intensity. So, duration is simply a time measurement.

So, this particular sound intensity sound intensity is measured by using sound level meter, which is basically a sound pressure meter that converts the reading to decimals. So, most meters are equipped to allow the user to set one of the several different scales when taking a sound pressure measurement. So, the tool 2 most important skills are designated as A and C by the American national standard institute that is ANSI, this there is a association. So, difference between this a and c is that they electronically weight certain frequencies of sound pressure signal differently.

So, the a scale is weighted to approximate the hearing response of human ear. And for this reason it is the most commonly used scale and one used by osha that is occupational safety and health act, So in fact, health agencies and just to establish noise level standards. So, decibel units for a scale. In fact, I am writing here decibel unit for a scale is dBA and for the C scale in internet to wait all frequencies the same. So, in this way, I think the sufficient minutes have been spent in order to understand the effect of noise.

On human being and the factors and the effects. So, I am closing this lecture right now.

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And just for a refreshing purpose I have added one fact that if you are right handed you will tend to chew your food on your right side. And if your left handed that you will tend to chew your food on your left side and again as an engineer.

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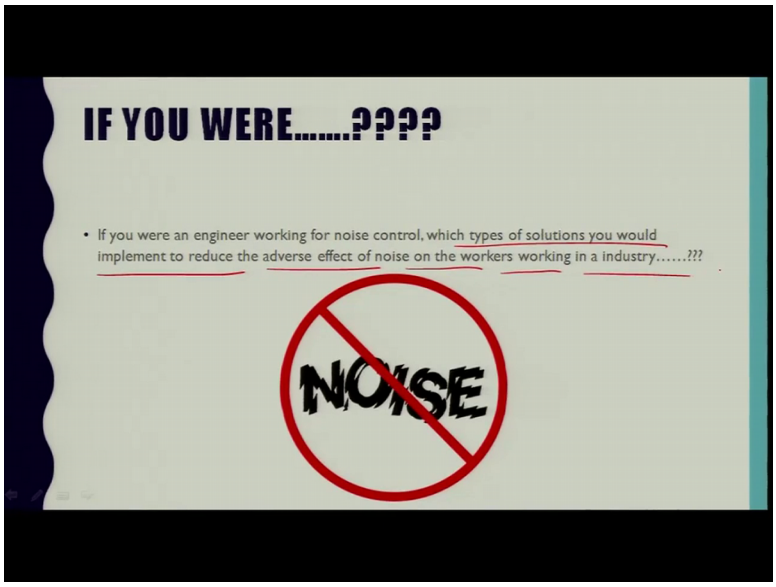

I suppose if you were working for noise control which types of solutions, you would implement to reduce the adverse effect of noise on the workers working in an industry think about that try to find out the solution possible ways in order to reduce the noise level and there is a graffiti for you enjoy it and till start at the next topic.

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Thank you very much for your patient hearing.