Ergonomics for Beginners Industrial Design Perspective

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Module No. # 06

Visual Issues

Lecture No. # 29

Visual Displays

Welcome to this twenty ninth session of ergonomics for beginners industrial design perspective.

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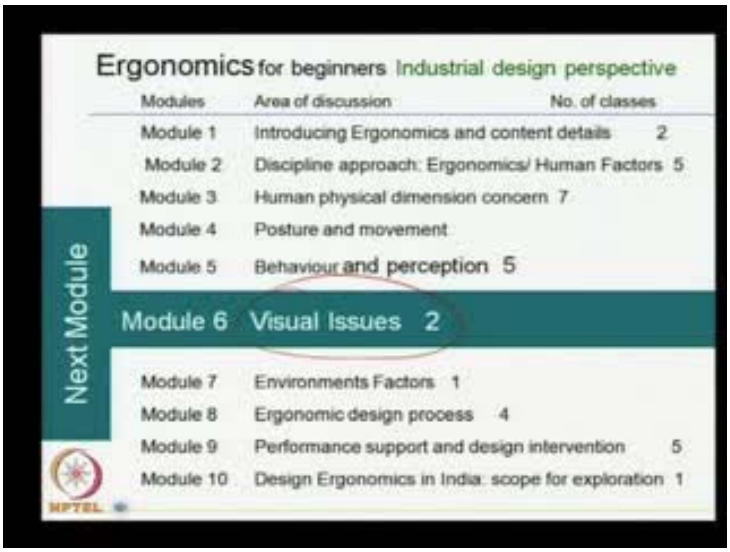

Today's module – visual issues.

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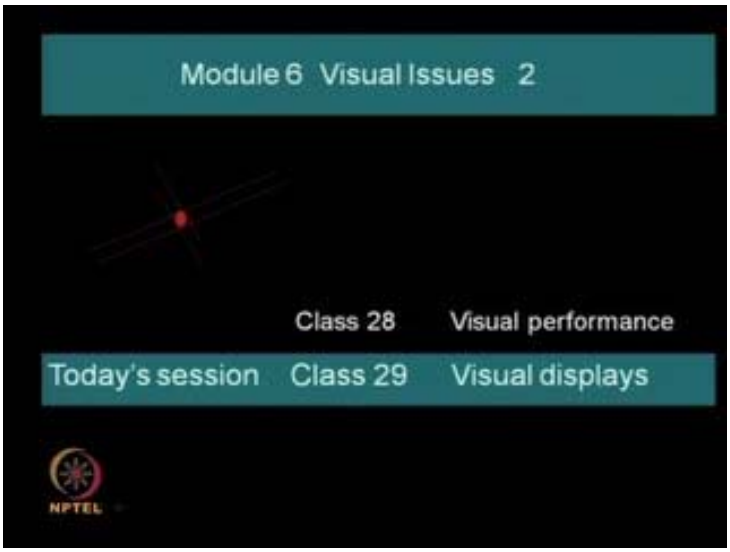

Within the two specific classes, class number 28; last time, we have discussed some basics of visual performance. And, today's session is class number 29 – the visual displays and relevant issues.

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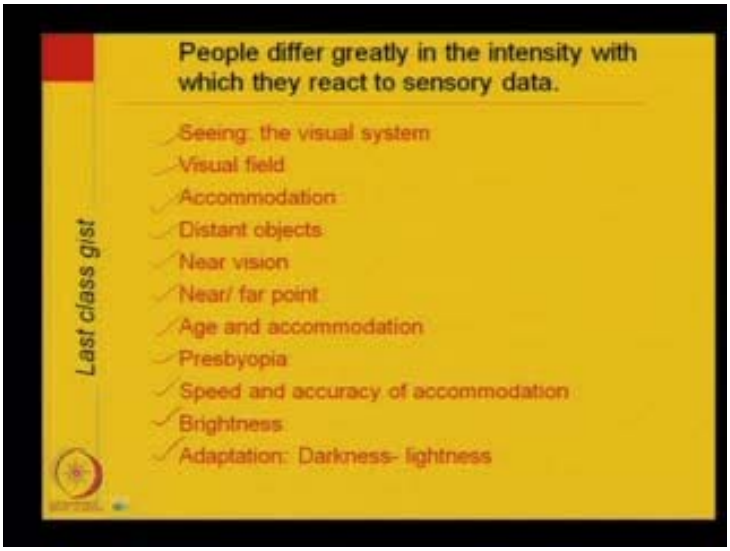

In the last class, we have discussed, the people differ greatly in the intensity with which they react to sensory data at specifically the visual information. There we have discussed, just to recollect, the seeing – the visual system; the eye structure and eye matter we have discussed. Then, visual field, accommodation, distant objects, near vision, near and far

point, age and accommodation, presbyopia speed and accuracy of accommodation, brightness and its effect on vision, adaption – that is, darkness and lightness.

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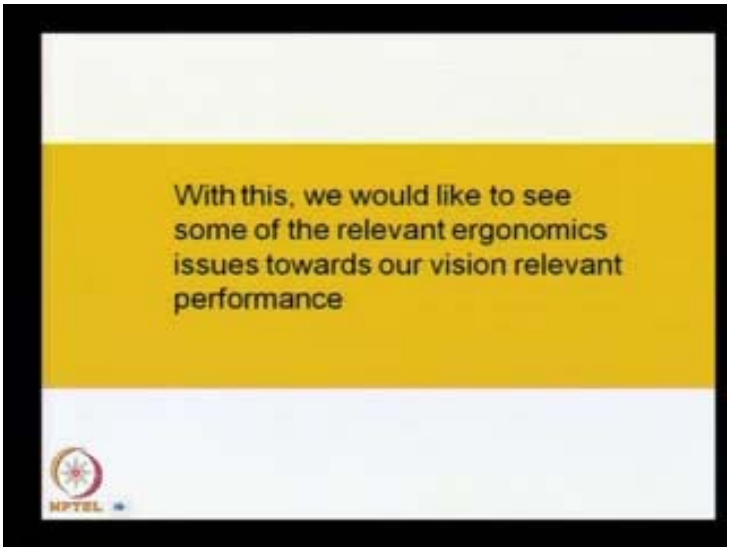

So, with this, we would like to see some of the relevant ergonomics issues towards our vision relevant performance, now.

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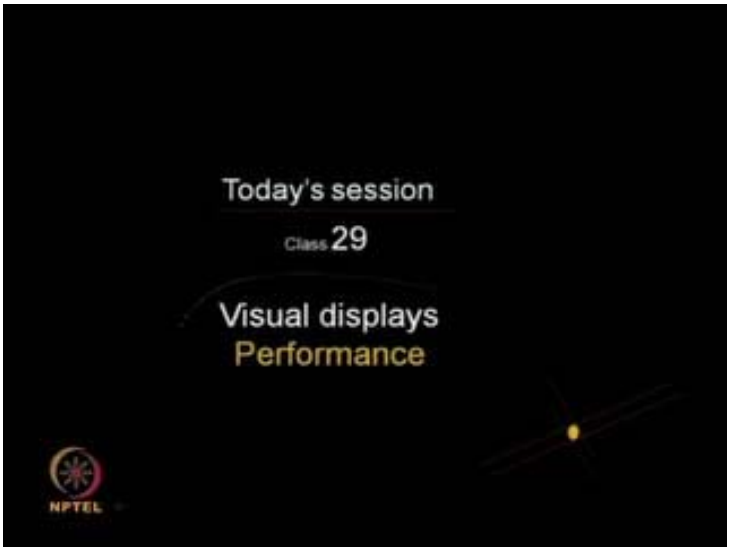

So, today's session, class number 29 concentrates on visual displays; that is, the performance.

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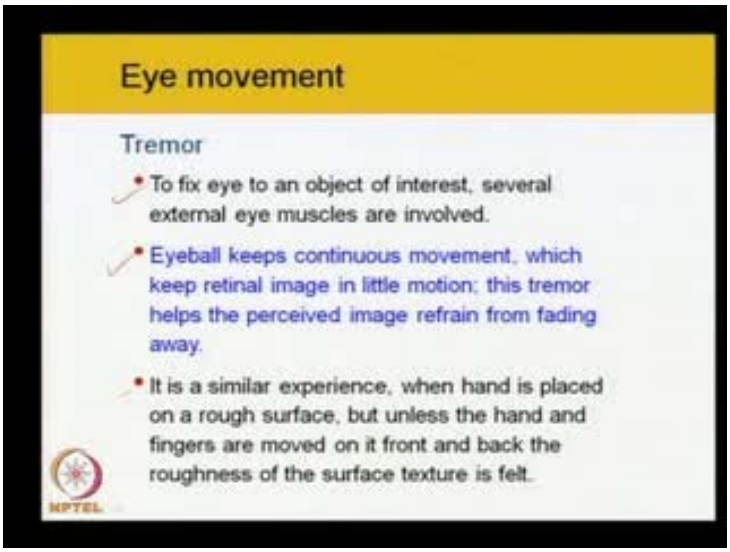

Now, some of the facts would like to discuss today that one aspect is that tremor. To fix eye to an object of interest, several external eye muscles are involved. Those eye muscles are holding the eye ball in that place; so, their movement it focuses. Eyeball keeps continuous movement; it is not fixed or which keep retinal image in little motion; this tremor helps the perceived image refrain from fading away – means when we see some of the interest object, our eye moves on that to get the total feeling. As for example, this action may be compared with – like it is a similar experience of when a hand is placed on a rough surface; but, unless the hand and fingers are moved on this, we cannot feel the roughness of this surface. So, to get the full visual effect, the eye moves frequently while focusing on some object of interest for vision. So, we can say that unless the hand and fingers are moved on it – means the rough surface – front and back, the roughness of the surface texture is felt. Similarly, eye also does.

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Now another point – that vergence – convergence and divergence; convergence and divergence if we see, the thing is that when we want to focus on a near object, our eye ball comes nearer to focus that close. When we focus on a distant object, our eye ball remains as much as parallel. But, sometimes, when we try to see the peripheral object in the visual field, eye tends to go in a divergence mode. So, depending on the visual field depth, both the eyes behave like this.

Now, another aspect we can say that the speed verses visual attention; now, perhaps when we drive a car or drive a motor bike, when our speed is very slow, eye tends to see in distant or in various objects that is not very center at both the sides; I can feel it to see. But, when speed increases, our focus goes towards the center of the road. So, when you are in a speedy, then we cannot concentrate or we cannot focus or we cannot see objects that are in the periphery area. So, the speed and visual attention has this relationship. Now, in any design where these things are necessary to be practiced, basic relationship we must appreciate; and, we consider it.

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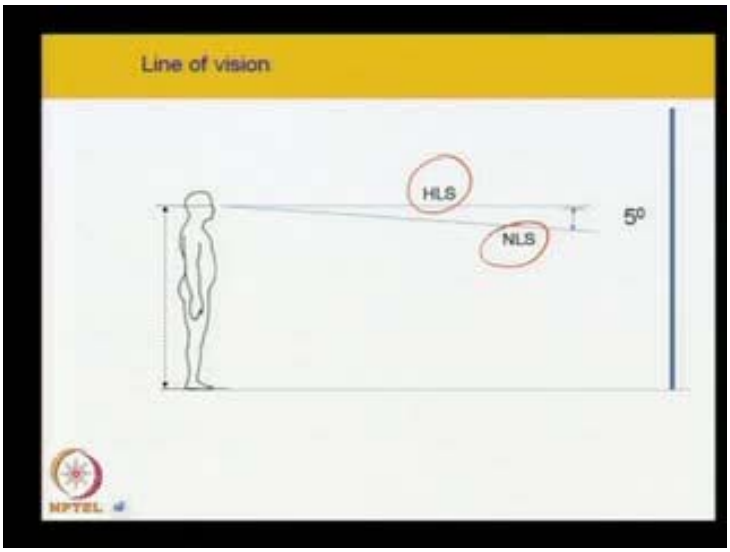

Now, line of vision – when we concentrate on some object, then from the eye height, a straight line if we draw… This is the horizontal line of sight. But, we cannot look at this position. So, mostly, what happens, either we see little below than that horizontal line of sight; around 5 degree below that, our eye feels comfort; or, if we have to guess that instead of making only eye balls move up, chin goes up, head tilted little back. So, eye balls comes little in a comfortable position to maintain that 5 degree inclination from that horizontal line of sight; that below 5 degree inclination, this is called normal line of sight. So, if we can keep all the important visual items acure at our eye height level, it should be below 5 degree; that is the normal line of sight.

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Now, how we can see an object? When you are seeing this object, some light is coming to me. So, I can see that. But, in the same line of sight, if another bright or more intense light source is there, then our eye draws attention to that high intensity light source. So, whatever the lower light intensity object I want to see, that becomes invisible or blur. So, this is one kind of effect; let us call glare effect. And, as I cannot see that object of interest clearly for the presence of brighter or a high intensity light source in that same plane, it is disability glare. So, like in this figure, if we see, that is the heavy light source; and, if I want to see something here, then this becomes blur or I cannot see it properly, because this is the high intensity light source, is getting my attention.

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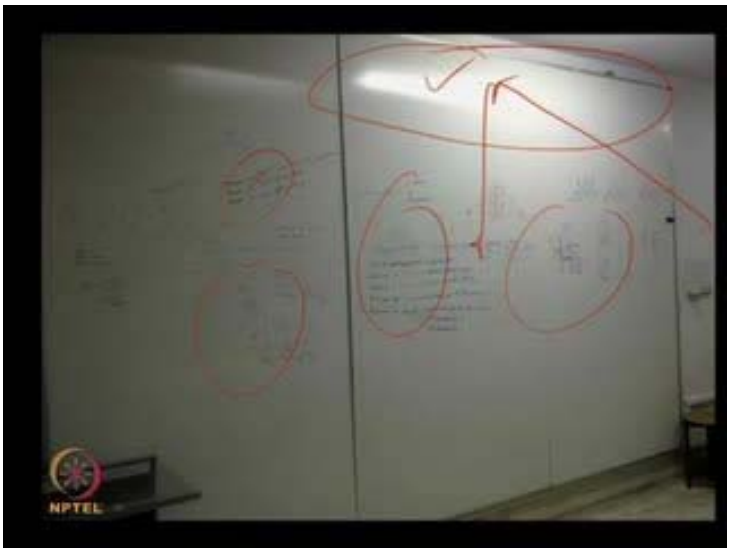

Now, another item is that in this case, in this figure, I can see whatever written material is here on this board. But, at this area, I see some reflection of some other light sources present just opposite side – means somewhere from opposite side, light is falling on it and then it reflects to me. But, still I can read and I read all the things whatever mentioned here. But, this glare gives me discomfort. So, this type of secondary glare is called discomfort glare. So, this discomfort glare depends on the location of light sources in the ambience.

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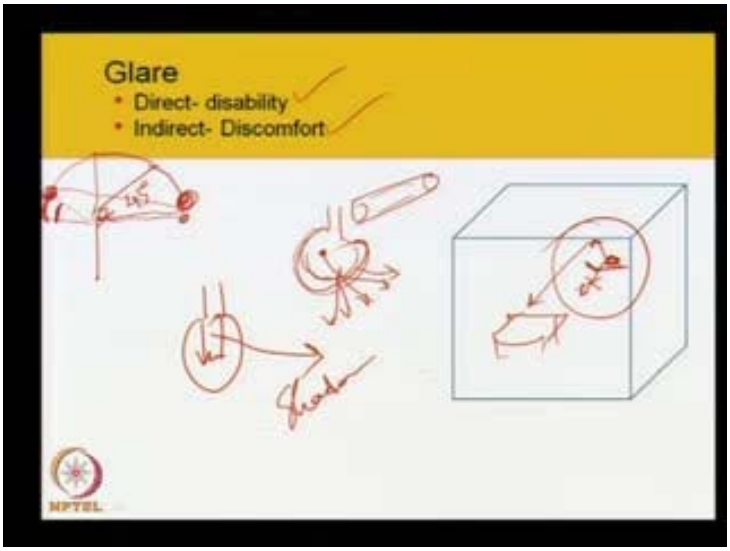

Now, the glare is direct glare, that is, disability glare; and, indirect glare, that is, discomfort glare. Now, the thing is that when a person is standing or sitting his eye height; and now, at this same line, if I want to see this object; and, very high intensity light source is there. So, from here to almost around 45 degree angle, if this high intensity light source is there, it gives you the disability glare effect though it gradually reduces. And, from here till 90 degree, it becomes very less or no kind of thing. But, the backside is also same; and, backside also from this 45 degree angle here, what happens is, if any heavy light source is there, it may come this way and then can reflects to the same light of sight. So, in the backside also, this 45 degree angle, it is better to avoid high intensity light sources installation. So, this is the direct or disability glare.

Now, discomfort glare is that… Also, both the sides… Now, if we keep some of the high intensity light source that from reflects, that falls on the surface and then it reflects to our eye, it gives you the discomfort glare. But, this glare also effects or its intensity increases or resists if we use the surface matte finish or glossy finish. Obviously, matte finish – it will be less.

Now another item comes; that the shadow effect of the light. Now, shadow effects of light if we see, that light sources; if there is an incandescent bulb, then it gives you direct light to the object; and then, it can create shadow. It gives a hot feeling, etcetera like that. So, this is the direct light source incandescent lamp type. Another light source, we can say that some diffused lamp; it may be tube type of lamp, tubular lamp or may be different type of compact lamps or some (( )) that has some coating inside; and, whatever light is being created here, it reflects and it gets give you a diffused lighting. So, in this diffused lighting, the shadow element is relatively less; and then, it also gives cool effect to the eyes. So, apart from these, another light source mostly we can experience in some cinema halls, theater halls or maybe restaurants; like in this room here, if we are sitting like this way or inside, (Refer Slide Time: 14:00) then a light source from this wall becomes… So, this is a wall like this; so, here if we have a light source, then no light is coming directly to the inside, but the light reflects goes through the ceiling and from there it reflects. So, the intensity reduces the reflection and it does not provide any shadow kind of thing; and then, it also gives us soothing effect. So, this type of indirect lighting system is also there. So, the glare and light installations like this creates an

ambience for good; or, for context-specific work requirement, it can create; and, ambience can be created.

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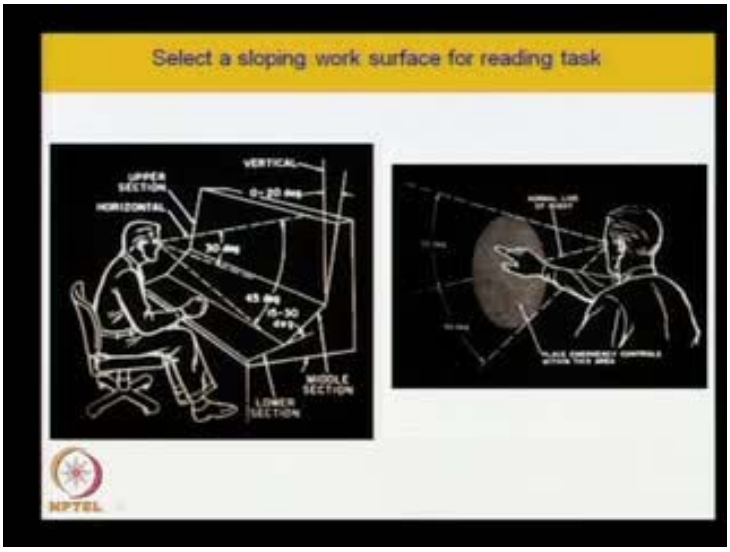

Now, when we see some of the objects like that the select a sloping work surface for reading task and etcetera; like in this case, now, in this person, from the normal line of sight, around 30 degree up without moving head or eye, one can feel the presence of some object or color also. And, below also, normally, it is 30, but it still goes till 45 degree from the normal line of sight; and, both the sights also, 30 degree, 30 degree; and, roughly, it can be shaded. So, this area is the normal visual field.

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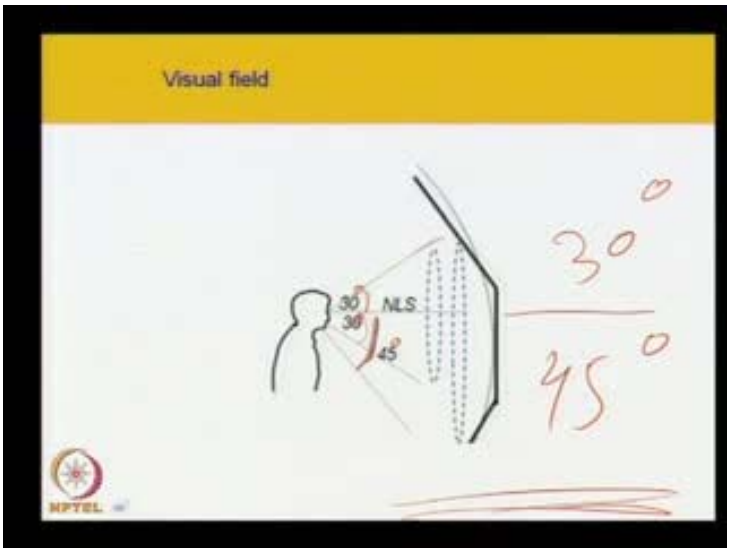

So, in this case, visual field – if I see like this, this is the normal line of sight; this is the surface area. So, from here above 30 degree and below 30 degree and it may go extent till 45 degree normally. So, 30 degree, 30 degree and below 45 degree; so, roughly, it can be said that this is 30 degree above head; and, below head, around 45 degree, is a normal visual field from top and bottom side. This is till where this 45 degree angle matches with the floor level; like that.

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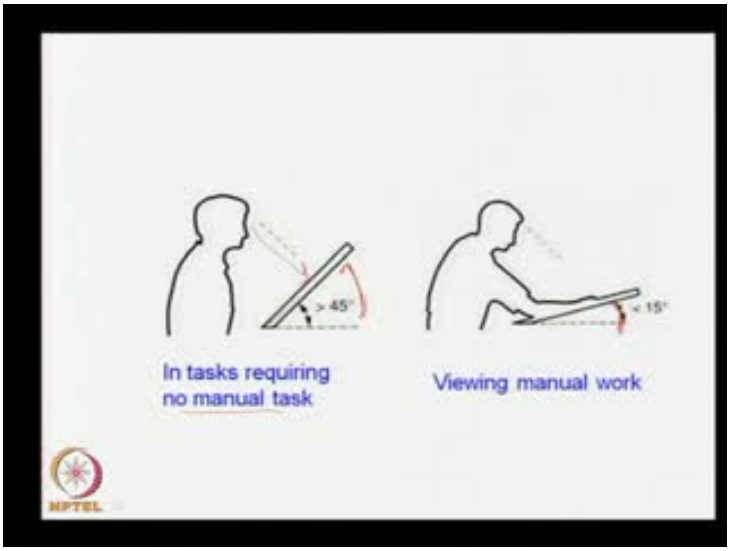

And, another thing is that this is for a seeing; but, now, while doing some tasks, we may need to concentrate on something to read and write. In that case, in tasks requiring no manual tasks, there around 45 degree angle; here it can be given. This slope can be given, so that it will be easier read and viewing manual work; where manual work is necessary, it may go around 15 degree kind of thing. So, this is not only for the handling part with the operation; also, it eases our vision.

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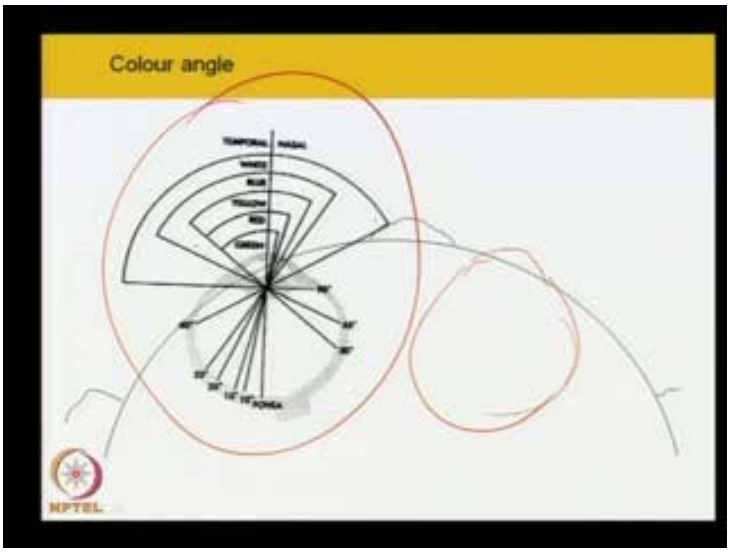

Now, for the both eyes, now different color has different color angles like when we see… Suppose we are sitting in a comfortable position; now, without changing eye movement or head, if head is fixed and eye also fixed, if I bring some colored object, then when we are bringing closer to my eyes, somewhere we can feel the presence of the object; but, we cannot recognize the color. When it comes little closer, then we can see the color presence. So, if we identify the color, then we can say that in this plane at this angle, I can perceive the object and I can perceive this specific color. So, now, at different plane also, we can feel like that way. So, accordingly, a special visual field for that color will appear. So, it is normally said that for red color, it is around 30 degree. And, for the white color, it is for the both eyes, both the sides, it is around 150 degree. But, at around 180 degree, one can feel the presence of some object. So, it can be said that for both the sides from this nasal point, red has around 60 degree and white has around 150 degree; like that. So, accordingly, different colors have different color angles; then, sideways and also up and down with this thing. So, here in this figure, it can

be seen such an example is given here (Refer Slide Time: 19:04). So, green, red, yellow, blue, white and etcetera; like that. So, this is that one eye; that we are showing it on left eye. So, accordingly, in this position also, that right eye also we can keep. So, like that. So, different color angles have… When it overlaps, it gives a total field.

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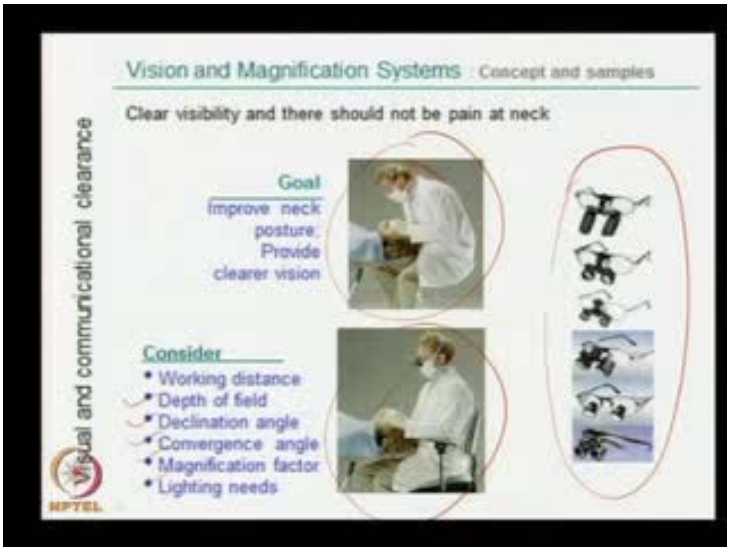

Now, the vision and magnifying system; now, visual and communicational clearances – now, a clear visibility and there should not be pain at neck. So, vision and neck matter we can see that… Suppose a doctor is checking… a dental physician is checking a patient. Now, here the goal is that for this task, improve the neck position or this neck bending improves; the posture needs to be improved and provide clear vision. So, like this. So, in this clear vision, while seeing all other areas evenly, still to focus on something, he requires some kind of magnifying. In this case also, the similar cases, what are the considerations? Here the working distance, depth of field, declination angle, convergence angle, magnification factor and lighting needs, all are to be considered. So, depending on this, varieties of spectacles with the magnifying attachment is available in market. So, a special development can also be looked into this type of requirements – means not only the special specs of the bifocal spectacles or something like that, it may have some specific thing where we can decrease or increase the magnifying as a specific requirement.

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Now, we will see some of the aspect of display, the eye height in a standing position or in a sitting position, eye height and varieties of light sources. That affects our vision. And obviously, if vision is good, then our performance will also be improved.

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One example – this is an exhibition entrance where some of the displays are shown here like department of design, presentation of student projects, the theme of this thing is that lakshya, etcetera. So, from a distance, we must see and go.

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But, the viewing distance has to be considered; like if we see the total place, then what happens? If we need to go like this in this position, go from here like this way; then, when we come from this distance, then how much is visible? So, the display and distance has some relationship; whether some obstacle is in between and how it is creating obstacles? Means what would be the population flow towards that object of vision that requires to be considered. So, relation between viewing distance and object of attention has to be maintained and studied properly, because we cannot say that it should be governed by a thumb rule type of situation.

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In this case, this is a shop for different visuals; items are there like visiting cards; and, some other things are there. Suppose a person is standing here; he wants to handle some thing. Then, now, has he goes up, then this distance increases – arm distance as well as visual distance also increases. So, he needs to bend forward to get good view. Instead of that thing, possibility, we may give a facility for this person to bend – means to reach; or, this arrangement we may have like this type of curvature; instead of this curvature, we may have this curvature, so that the distance wise also will be same and vision consistence would be maintained. So, for the visual display, etcetera, this type of arrangement one can consider.

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Now, another object – this is in a vertical plane, we need to see and operate. So, everything is visible like this; now, it creates an ambience.

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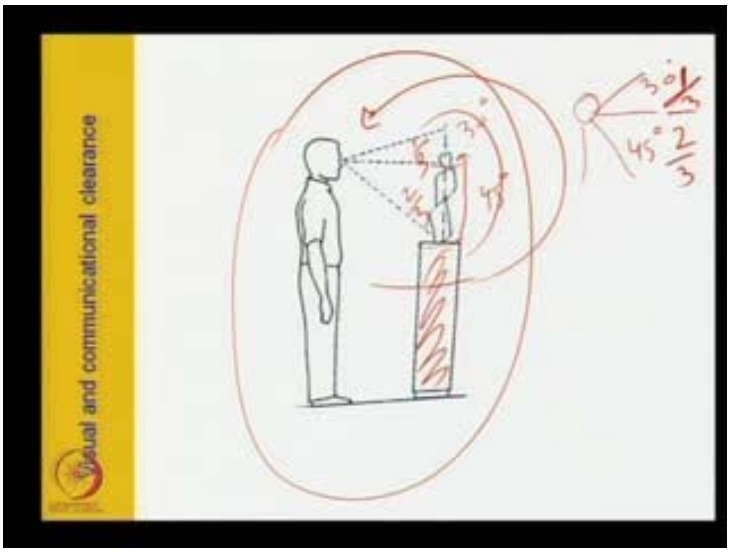

Now, thing comes visual and communicational clearance. Earlier we said that from this vision point, around 30 degree up, one can see without much changing head; and, below 45 degree. And, that should be within one arms reach distance. This can be considered. As for example, we can say that this is one exhibition area. Now, roughly, we can say if this is one, then this may be the two unit kind of thing; or, we can say that 1 by 3 and 2 by third; like this. So, 30 degree and 45 degree; we can divide like this roughly. So, if this is a product of interest, we want to exhibit; from the eye height, this may be around 30 degree up and this may be 45 degree below. So, from this point, this may be placed; around this is at one-third up – this position and below two-third; below this position, it can be placed. So, the person can move around and can get the good view. And also, can touch it. So, for different eye heights and etcetera, this may be considered. And, after doing this, this stand dimension can be fixed.

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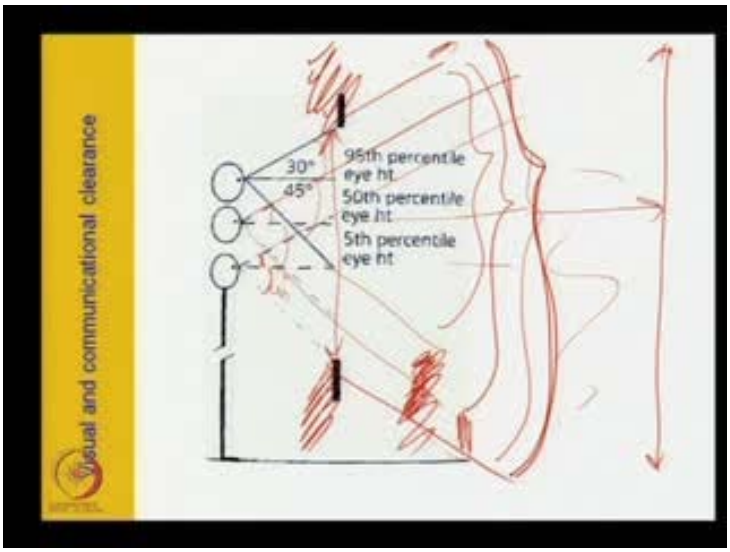

Now, another thing is that suppose there is a wall in front of him and then I want to see; suppose this is a wall – closed wall. So, this is the visual area. Visual area – we want to see something here. Now, for whom eye height we should consider? If a tall person comes in 95th percentile eye height, for him, this will be the 30 degree position and this will be the 45 degree position below the lines. So, for him, this area is the good area. So, he can see this area. But, if a middle height person comes; if 50th percentile eye height person comes, for him, this is the 30 degree and this is the 45 degree; like this. So, what happens is the upper; it is within his view, but below a portion is being cut here; he cannot see like this way, because it is closed here. So, then what happens? We can say that the total clearance will be till here, so that a tall height person as well as average height person can see both the things.

If a lower height person; that is, suppose 5th percentile eye height person comes, for him also, this is the 30 degree upper vision. So, it reaches here. And, below is the 45 degree here; it is his lower vision. So, then he also cannot see this much space, because it is being covered here. So, for him, we can say that this upper – this one and this one would be better. So, considering for three different height persons, if we have from here to till this level, (Refer Slide Time: 28:29) then this area will make all the type of people to get clear vision and like that. So, then as we increase the distance from the eye, this will be more; when it comes closer, then this opening will be less. So, this principle can be

applied while making any kind of visual screen or something like that; it may be in car or somewhere else.

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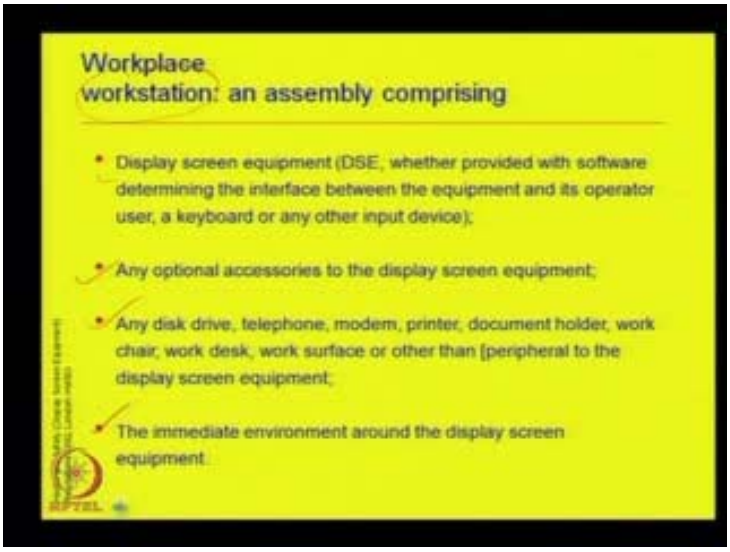

Now, the workplace or workstation as assembly comprising display screen; like that; normal (( )) equipment, display screen, like that – whether provide some software or something like that – keyboard and etcetera. Any optional accessories to the display screen equipment; any disk drive, telephone, modem, printer, document holder, work chair, work desk, work surface or other than peripheral to the display screen equipment – all are required to get that workstation. The immediate environment around and display screen equipment – all these things concern the work station.

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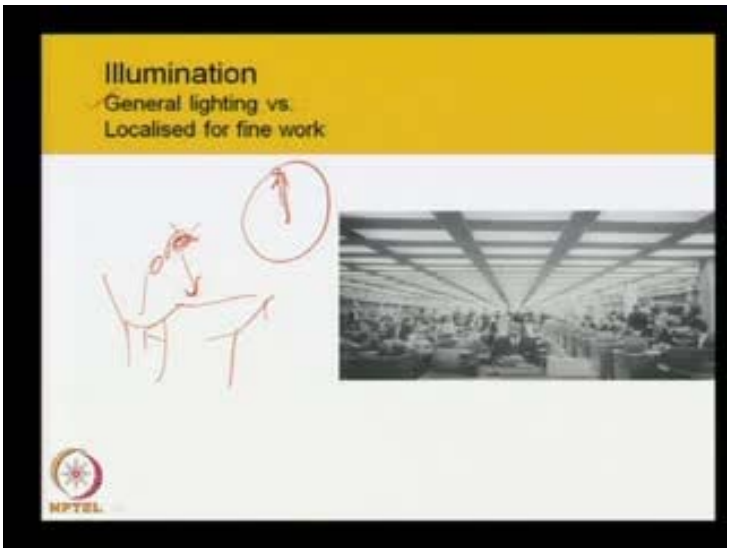

Now, if we see the illumination level in a work place; so, work station is that here the person and the work equipment at his surroundings, so that he can touch and can get attention as and whenever required; and, the space within that you see that work station. So, similar work station if we multiply total with the links in between the work stations, that becomes the work space and work place accordingly when it increases. Now, for general purpose, to a create an common ambience, the illumination should be even; that is the general lighting – general lighting that is shown in this figure. And, another thing is that with this general lighting, if a person requires to concentrate on some work area, then he has to get some kind of special localized light sources, so that it can give him more intense light.

The specific requirement – now, for this whether, this light will be incandescent lamp type or some kind of diffused lamp type of thing it needs as its requirement. Normally, what happens? An incandescent lamp provides shadow. Now, whether the shadow is necessary to complete the task or not? Like when we see a meter reading, the needle and its shadow should match together to give a proper reading. In such cases, the shadow is necessary, but when we require to have an even lighting, but still localized. There the diffused lighting lamp systems should be better. Now, another points comes; to create a general illumination, whether a heavy intensity light source – single or less in number should be there or there would be many light installations with a lower intensity lamps? That is a question. Now, it is it is found that to create an object to create an even lighting

source, low intensity power lamps, but many in number is preferable than a single heavy intensity light source.

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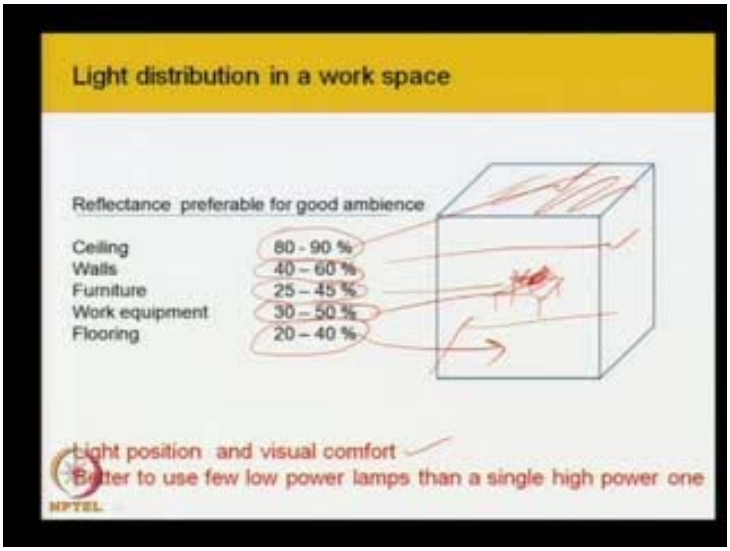

Now, another thing comes; that light distribution in a work place. Now, in a specific case or in a specific place, where you are working, whatever light is present or light intensity is required to perform its task, from ceiling walls, floor, furniture and the object of interest, how much light should reflect to me to have a balanced ambience. It is seen that the… And, each and every color also has specific reflectance value like different… Suppose how we can see a color red, because all the light sources are falling on it; most of the other color light rays are being absorbed in layman; we can say it. And then, the red light – as it is not a being absorbed, it comes to my eyes; so, I can see it. So, how much light totally falls on the surface and how much is reflecting? That is the reflectance value of that lighting; like that. So, simply we can say that from a ceiling – obviously, this is a room – from the ceiling, around 80 to 90 percent of the total lights should reflect; this walls – (Refer Slide Time: 34:32) around 40 to 60 percent light should reflect. If there is any furniture, then from this furniture, around 25 to 45 percent should reflect. And, if there is any work equipment kind of thing, like that, it should reflect around 30 to 50 percent; and then, this floor – it should have around 20 to 40 percent.

Now, one question comes – why this flooring needs 20 to 40 percent? There is a common psychology that if the floor is too much lighted, then we may not feel

comfortable while working on it. It gives a pseudo falling tendency kind of thing; or, we may not feel that our foot is well placed or well grabbed on the floor, because we must feel that – normally, it is said that it may be a psychological thing that the lightness in color also gives lightness in white filling. So, when the floor becomes little dark, then we also feel that yes, it is wet; so, we can have a strong foothold on that. It may be a psychological implication. Now, its practical application or practical experience – we can said that in some temples nowadays or some special housing also, they have very glossy; or, very high intensity light reflectance colors they are using. So, while walking on that, it keeps little uncomfort. Instead of that, any grayish type of flooring gives you comfort while walking.

Now, the light position and visual comfort also we need to consider. Now, how we can make this arrangement of reflectance. Now, if we use some color, there are varieties of different colors as different reflectance values. Accordingly, if the colors are used, it will better; like white color – it has around 80 to 90 percent reflectance. So, if on that ceiling, if we use that, obviously, it will reflect that type of color, that type of light. So, this type of application. Another application is that whether to need to have pleasant feeling or not? Suppose this is a dwelling house; in this dwelling house, if there is a pillar in between, we are quite aware of that pillar; we do not want to see it; I want to avoid its presence; then, some cool color – like if you see that gives you range, then blue, green – that type of color can be used; or, cool color combinations can be used on that and may be some floral paintings and etcetera should be used, so that it gives some soothing feeling and we can avoid it presence. But, the same thing in a shopping mall or in a public place, somewhere, there that pillar needs to draw your attention; otherwise, some accident may happen. There red, yellow, orange or that type of color or maybe some kind of combination of that can be used, so that it should draw you attention about its presence. So, the application of color and then visual perception and visual preferences and accordingly, your work activity – it has all relations like this. So, this needs to be considered. So, light position and visual comfort we need to consider. And then, better to use few low power lamps than a single high power one, is always preferable.

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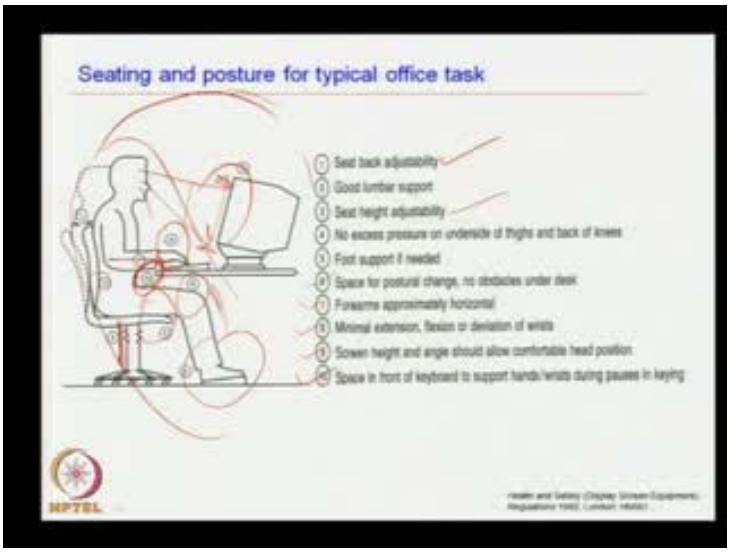

Now, if we see, specifically, a seating and posture for typical office task – if this is a specific work area, work posture, here we can say that what things are there. So, one, that is that the seating back adjustable; number 2 is the good lumber support here; this one – seat height adjustability; no excess pressure on underside of thigh and back knees – that is number 4 – here this portion. Foot support if it is required; then, space for postural change; no obstacles under desk, free leg room; and then, forearms approximately horizontal – forearms have to be this one – approximately horizontal to the floor and the work surface. Then, minimal extension, flexion and deviation of wrist – this facility to be provided; number 9 – the screen height and angle should allow comfortable head position – this screen height like this. So, in this case, that visual angle and visual field should be considered. And then, space in front of keyboard to supports hands and wrist during pauses in keys – this area is also necessary to consider. So, while making all these things, not only the physical dimensions, but the visual clearance and etcetera, visual requires to be considered.

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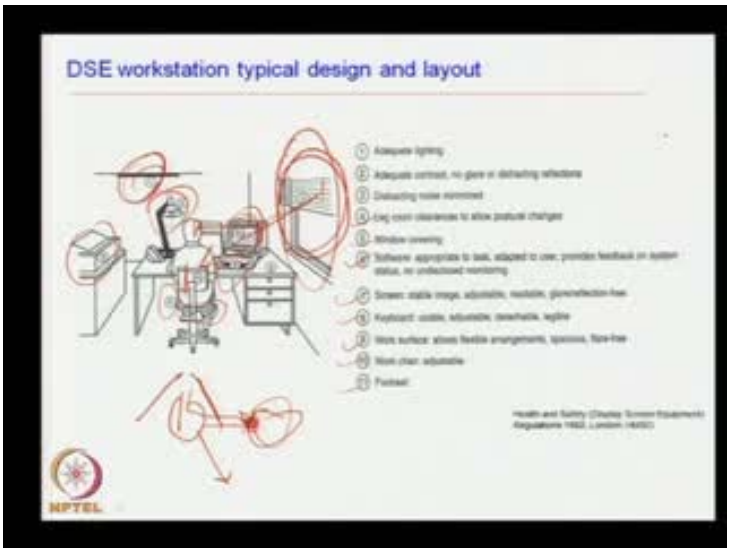

Now, from this, again we can say that a typical design workstation and layout. In this case, we can say that number 1 is that adequate lighting sources. Number 2 is that localized light source – adequate contrast no clear and distracting reflections. Number 3 is that distracting noise minimized; number 3 – this printer, etcetera. Number 4 is that leg room clearance to allow all these things; number 4 – this is n. Number 5 is that window covering; why this window covering is there? Because while seeing this computer, there may be some kind of glare effect to the eye; so, this blind and etcetera needs to be considered. Number 6 – the software and etcetera; how we are working; the software appropriate to the task, adapted to user, provides feedback on system status, no undisclosed monitoring; so, the clear vision should be here. Then, screen stable image, adjustable, readable, glare and reflectance free necessary. Number 8 – that keyboard and etcetera – keyboard usable, adjustable, detachable, legible. Then, number 9 is that work surface – this one; this table top surface; work surface allows flexible arrangement, spacious, flare-free. Number 10 is that chair height adjustable; that is the backrest adjustability. And, the foot rest – if it is necessary, it can be provided.

Now, in this, the two things from visual importance – visual field issues is that one is this one – that window that may create some kind of glare effect when we are working on the computer screen; otherwise, it may be open to give a natural light source. Now, this lamp, etcetera should be placed in such a way that it does not give any discomfort glare to the eyes. Another point is that this localized lighting system – it has to be always; if

this is the eye (Refer Slide Time: 43:18) of a person, then the lamps… Suppose this is a lamp; it gives a direct glare. So, the shadow or something should be in such a way that no light should fall directly to the eye; it should fall only on the object of interest only. So, like that, height has to be adjusted. Another thing is that when we read or something, if we keep a light source towards me, then what happens? Direct light reflecting from the pages comes to me; it may give some kind of uneasy glare. So, it is always preferable that if we can keep the light source from some angle, so that main light will fall on it, the main reflection will go away, but secondary reflection comes to my eyes; I can read it with smoothness. So, these are some of the aspects of lighting positions and sources one need to consider.

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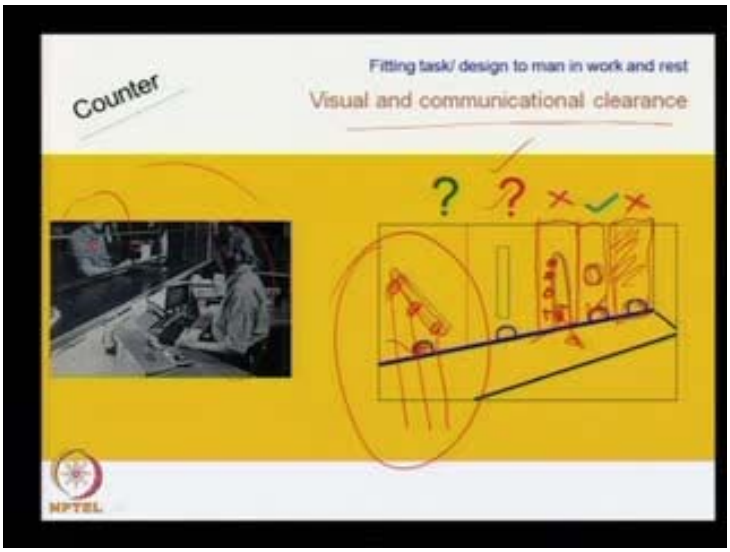

Now, another point we can say that this is… Though in the next classes, we will discuss this in detail, but now, here we are just telling that the counter – the fitting task or design to man in work and rest, the visual and communicational clearance; like in this type of case, we can see that the counter person and then the visitors need to maintain the eye contact. So, while making the eye contact, what would be the specific features? Now, mostly, we can say that if we see in this case, there are some specific cases; if we see this area, this area, in certain counters, this is totally closed and only one small opening is given. So, here what happens, it is very difficult to speak; and, only pushing the hand, one can operate through this. So, it has little problem. So, we can say this type of design may not be suitable.

Then, we can say, in this case, have two holes. So, these are for visual, speaking kind of thing and you can see through this (( )) glass, and you can open it. Then, it comes whether a tall height person, middle height person or a short height person, whose face height or eye is there. So, though it is good, then the tall person has to bend and speak like this way; and, short person has to do like this way (Refer Slide Time: 46:11) or short person will use this lower one together to do like this – this type of atmosphere. So, it may be possible, but it is not very good. Then, second thing comes – if we can make a arrangement like this, this is a glass and have a cutout like this, so that different height people can face. So, a tall height person can face here; middle height person can face here; and, short height person can face here and can operate through this. It apparently it looks nice, but another thing is that there may be some nuisance, because this much cutout any one can keep that hand inside without any resistance; that may not be possible also.

Then, another thing comes – whether this would be possible? Now, one question comes – perhaps when use you are standing on a railway booking counter, normally, what happens? The person stand at the counter; he is talking to the counter person; and then, the computer screen is kept towards the computer person and he is checking. And then, this person also still wishes to see through this window, what is happening there in that computer screen. So, when that dealing is going on, the second person he is getting ready psychologically. And so, how to counter (( )) When his turn comes, from the side, he is trying to see what is happening inside. And, the third person behind also gets, but not through this; he tries to see from other position like this (Refer Slide Time: 47:55). So, mostly, person when at queue like this – three persons near the counter – they have this type of behavior.

Now, with this, to maintain that behavior, we can have one idea that if we can have… To cutout this thing, one can have a face; and then, stop is here; and then, this is a handle. So, this may be possible. But, still what happens, to handle this situation, if we can have a cutout like this way where possible, by automatic natural selection, the tall person will stand somewhere here; middle person will stand from here; short person may stand from here; but, they can operate through this hole. So, whether with this normal selection, they can select according to that cutout? This is just one idea. It needs to be practiced. So, by this, we can say that not only the visual touch, visual connection, the motor consider

work connection as well as our behavior. It all needs to be considered while making a design application. So, these are some of the thoughts. If we think in this line, then a good solution may come up.

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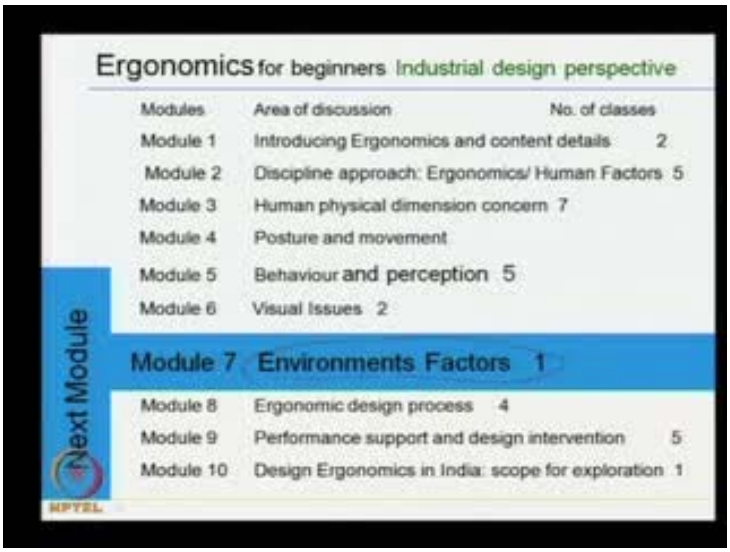

With this, today, we have finished the normal visual issues. And, some of the points whatever we have raised in this like in the last slide, whatever we are discussing about this counter matter, will discuss in next pages; like specific design – when we discuss. So, the next module – the module number 7 – we should proceed from here; that is, that environmental factors – heat, humidity, ventilation, etcetera; vibration and how it effects our performance; and, how it can be applied in design activities, so that we can get maximum benefit out of these applications. So, till then, thank you very much. So, next, we will see.

Thank you.