Safety in Construction
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Lecture-6
PPE in construction

So, today's topic is primarily on PPE which is nothing but personal protective equipment. And when you talk about safety then PPE is interlinked with safety. So, you cannot proceed with safety without mentioning on PPEs**.** Let us talk about PPEs and primarily most of you know what are the different PPEs. But in today's class I will be talking about the different types of PPE and for different hazards, what are the PPEs required and so on.

And I will be giving a lot of references from OSHA and IS code, and as far as PPE is concerned there are so many IS codes available on specifications. So, I have only brought few but there are few more IS codes available. So, now let us move on with PPE.

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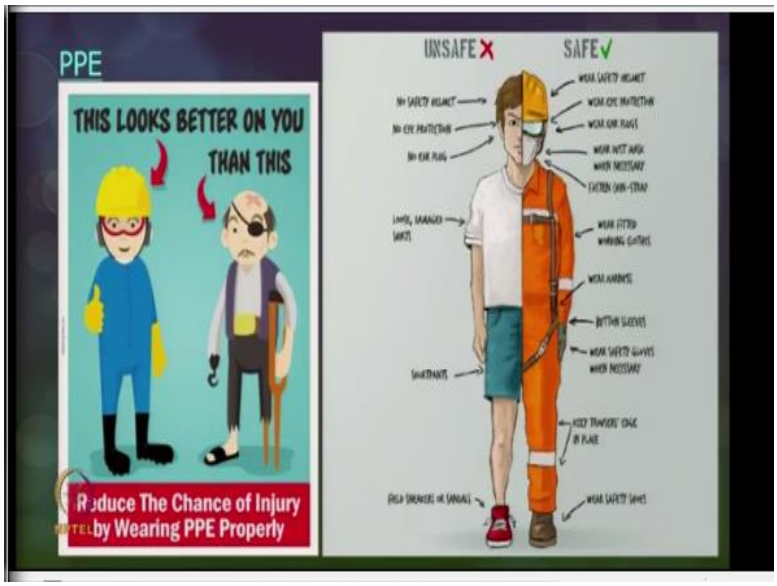

So, these are some of the cartoon pictures which will tell you the usage or the purpose of PPE.

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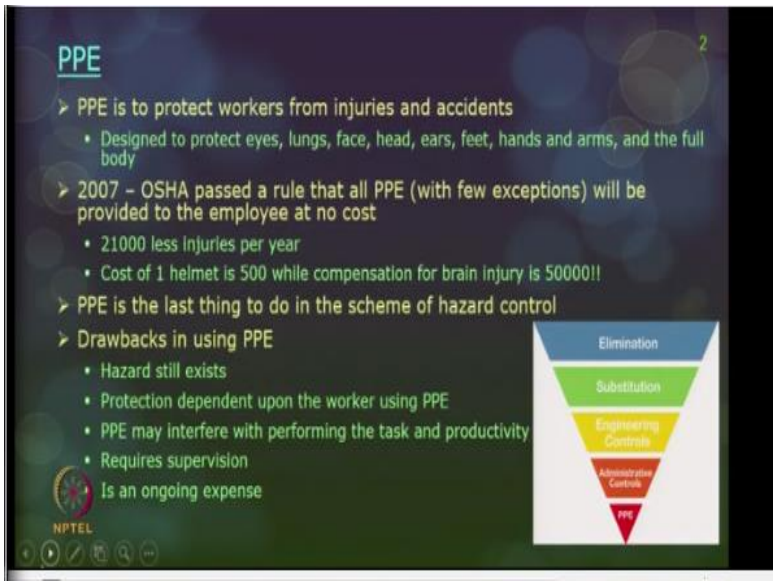

So, what is PPE? So, PPE is to protect workers from injuries and accidents, and they are designed to protect the specific organs of a human being**,** it can be eyes, it can be face, it can be head, it can be ears, it can be legs, it can be hands or arms or the full body. And in 2007, Occupational Safety and Health Act they passed the rule that all PPE may be few exceptions here and there should be provided to the workers at no cost**.**

The workers should not be charged for the usage or for the purpose of putting the PPE. And after this law was passed almost 21,000 injuries were just minimized every year. And if you see cost wise also, just an approximate idea, I would give you cost of one helmet is just 500 but compensation for a brain injury is something like around 50,000. So, better to go with PPEs, and why to suffer on human sufferings and human loss or something.

So, PPE is the last thing to do when it comes to the scheme of hazard control. So, this week when we are discussing about hazards you will also understand. So, hazard, first step is to eliminate a hazard and if elimination is not possible you can substitute. And if that is also not possible you can think of engineering controls and administrative controls in order to protect yourself and the environment. If nothing works out, then the last resort is to go with a PPE.

So, PPE will actually help you to escape from the injury in some ways or the other or at least will minimize the impact even if the accident occurs. And even when you wear PPE do not think you

are completely safe in a construction site. Because you should keep in your mind whatever hazard is there, it still exists. You are only using a PPE to minimize the injury or an accident impact.

And the protection also onto the worker depends upon the worker and what type of PPE is he using, if you wear, if you have chosen a wrong PPE, then that is not going to protect you from the particular hazard. And PPE sometimes may also interfere with performing the task and productivity, maybe in a very hot summer, if a worker is wearing a complete overall PPE with hard hats, helmets, legs, shoes and so on.

So, in spite of protecting the worker, it is going to be uncomfortable or the productivity of the worker is not expected, so that also should be kept in mind. And also, the PPE require supervision, especially for respiratory protection and so on. You should also monitor and inspect whether the PPE will do your task. And the workers also should be trained how to use the PPEs under what situations they should avoid even using a PPE.

And the other issue with PPE is it is an ongoing expense, forget about the initial purchase and maintenance cost, storage and all these is primarily like a recurring expense for an employee to continue with these projects. So, that is also some of the issues with the PPE and why PPE is not taken up very seriously**.**

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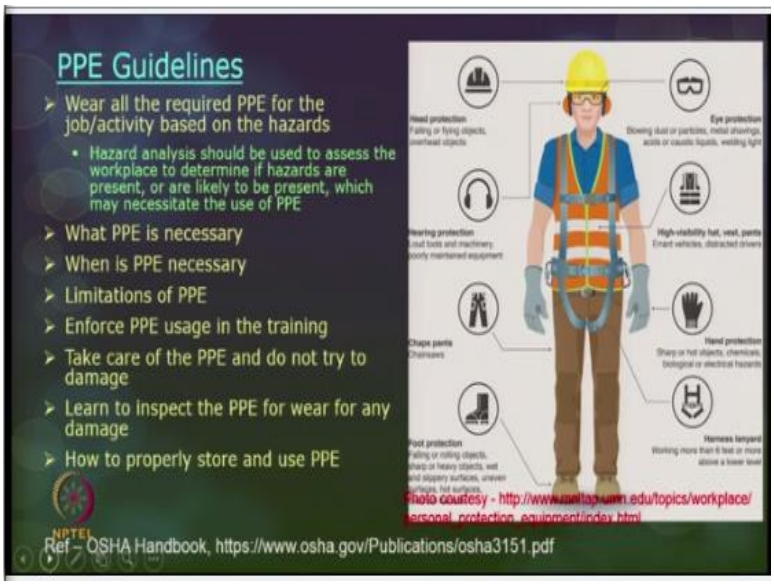

But PPE can really help minimize the impact of an accident, just by wearing a PPE, keep sure accidents may happen, that is no guarantee that accident will not happen. But even if the accident happened instead of maybe an amputation of your hand or arm, you may at least go with some cuts or scratches or maybe a fracture and you will escape from the severe impact, so that you can really expect with the PPE.

Now what are some guidelines for PPE? So, where all the required PPE for the job or the activity and how do you choose the PPE, it is based on the hazards in the construction site. So, suppose for example, you have to do some tasks for the day or for the entire week. Based on the type of hazard, you have to assess the nature, the exposure limits and everything on the hazard and accordingly you have to choose the right PPE for the work activity.

So, what PPE is necessary, whatever PPE is advised for the particular hazard, you have to use all those PPE. And till the time you are on the job site, you should be using the PPE at all times. Limitations of PPE, yes it does not mean that all PPEs are really good, so for example, safety helmets, you should check for cracks or any damage on the helmet, so all these are not safe helmets.

So, just because you are wearing the helmet, it does not mean you will be escaping from the head injury. Enforce the PPE usage in the training, so when the workers undergo the training itself,

you have to be adequately enforcing the usage on what PPE to be used and how the PPE should be used by the workers. Last but not the least take care of the PPE and do not try to damage or something because it is going to take either your life or somebody else's life.

Learn to inspect the PPE, so during training, you should also be training the workers to how to inspect, how to use, how to wear and so on. So, training on PPE itself is a very critical topic and very challenging and how to properly store, so that it can be reused, so all these are to be taken care of. Now, if you look at the PPEs there are so many places where the different types of PPE are used, let us start from the top to bottom.

So, first is head protection safety helmets or hard hats, then you have eyes either you can go with an eye protection or a complete face shield. And next is ear protection, then you have complete full body protection, then there is hand protection, hand or arm protection and then foot and leg protection. So, this is how the different PPEs are arranged and we will discuss what are all the varieties available.

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So, number one is head protection. So, what for you should wear a safety helmet or a hardhat? To prevent heavy head injury from either from a falling object, maybe you are actually walking beneath a scaffold or maybe some formwork and by mistake some materials can fall off from the

scaffold or from the roof. Then you have to have a proper hardhat to prevent any head injury from falling objects.

Flying objects that may protrude, so this is primarily when you are working on cutting or welding tasks in any construction site. There may be a lot of hazards on flying objects, so there you may have to use a proper hardhat. An accidental bumping of head on fixed objects, maybe you are working on a very congested site. And accidentally you may hit on a beam or some objects which are protruding in the site and to avoid any head injury you should definitely go for a hardhat.

The hardhats require a hard outer shell under shock absorbing lining and there are some certain tests also you should do for assessing the quality of a safety helmet. One is it should absorb the shock of a blow, so that any falling object falls on your head, your head is still safe and your hardhat is protecting your head, penetration resistance, primarily for again falling or protruding objects.

Flammability resistance, suppose if you are working near fire substances, flammability substances, it should not be yielding to the burning it should be maybe slow to the burning process. Electrical resistance, primarily for electrical workers, other one is water absorption it should not be able to observe water completely and other last one is a heat resistance. Now there are some ways of wearing the helmet, so helmet is not for fun sake, it is primarily for safety issue. So, you should wear the safety helmet in a proper way as shown in this figure.

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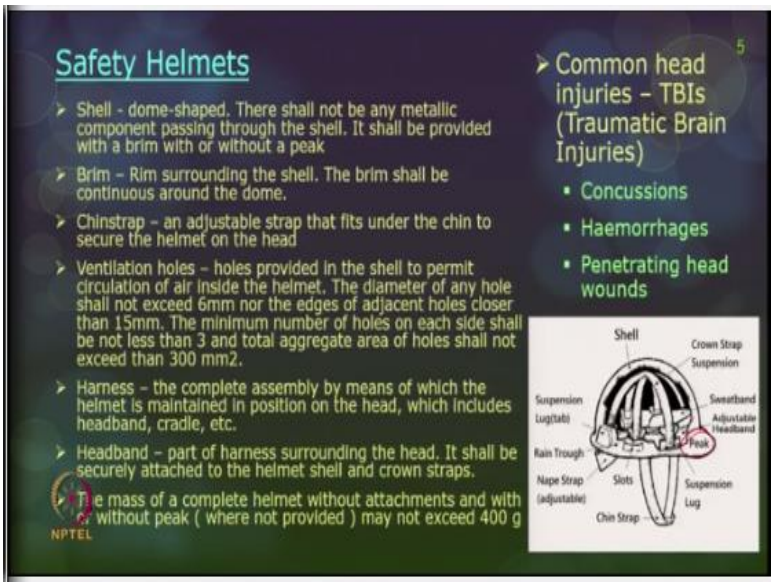

Now what are the common issues or terminology with the safety helmet? There are so many terminologies related to safety helmet and a lot of specifications are there with regard to the design of a helmet itself. First one is shell which is primarily the dome shaped cover, and this can be of any metallic component passing through the shell and it can be provided with the brim and there can be a peak or no peak options also.

So, what is a brim? The brim is actually the rim which is surrounding the shell, you have this dome shape and there is primarily a circular surrounding place and that is primarily called as a brim. So, in this picture if you see here there is a peak here, so this is primarily the peak. Now next is chinstrap, so primarily that is to safeguard your helmet from any displacement or movement of the helmet on your head.

This chinstrap it is an adjustable strap that fits under the chin to secure the helmet on your head. The next is ventilation holes, there are certain holes given only for air circulation, and again there is a lot of specifications as to how the holes should be in the helmets. The holes are provided in the shell to permit circulation of air inside the helmet and the diameter of any hole shell not exceed 6 mm nor the edges of adjacent holes closer than 15 mm.

So, the spacing between the holes and diameter of the holes are mentioned, and there can be minimum number of 3 holes available on a helmet. And the minimum number of holes on each

side shall be not less than 3 and the total area of holes shall not exceed 300 mm^2. So, you cannot have too many holes in the helmet, so rigidity of the helmet also will be lost, all the specs are given in the IS code.

Harness, the complete assembly by means of which the helmet is maintained in position on the head which includes a headband, cradle and so on that is primarily called head harness. Headband, it is a part of the harness which is surrounding the head it shall be secured to attach to this helmet shell and the helmet shell. Now the mass of a complete helmet without attachments may not exceed 400 grams.

Again, the weight of the helmet also there is a specification given, and there are a lot of varieties of tests to do on flammability resistance, shock absorption and heat resistance and so on, given the IS code, so if you are interested you can go through that later on. The common head injury is primarily called TBIs which is nothing but traumatic brain injuries. And apart from that the other common injuries are concussions, hemorrhages or penetrating head wounds these are all the different types of head injuries.

And when a survey was taken up, many of these workers did not wear a hardhat when these accidents happen. And some of these workers were also have wearing a hardhat but did not wear as per the specification for the hazard.

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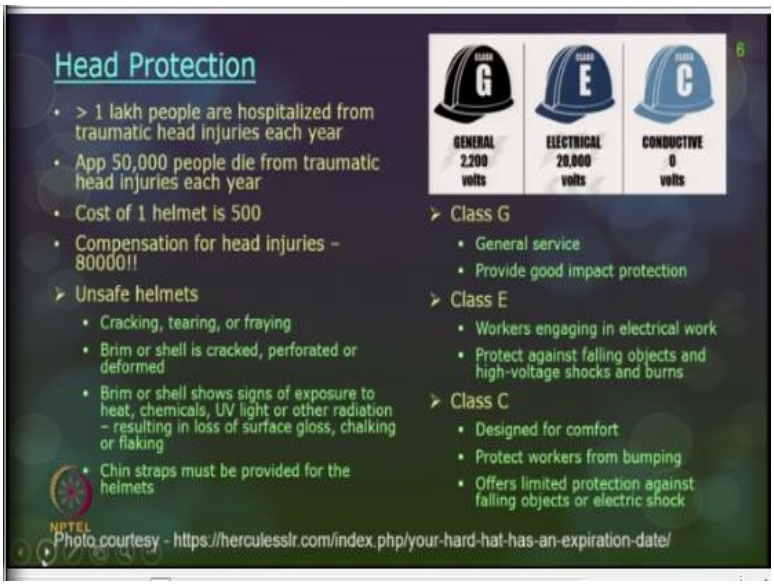

So, there is some statistics given, again this is not a recent one little older statistics, almost 1 lakh people are hospitalized from traumatic head injuries each year. And if you see many of these injuries are primarily because they did not wear a hardhat when the time of injury happened. And unsafe helmets, what are all considered as unsafe? Any cracking or tearing or fraying on the helmet is all considered unsafe.

Which implies the shining surface of the helmet is lost, it implies it has lost its full strength capacity. The brim or the shell also should not be cracked or perforated or deformed then it shows it is an unsafe. The brim or shell shows signs of exposure to heat, chemicals or UV light and so on, so which can be seen by loss of surface gloss. So, the shining surface will be little lost or chalking or flaking.

Somewhere you will see a lot of white space coming onto the helmet which implies it is not safe to use. And chinstraps must be provided for the helmets, if it is not provided then it is not a safe helmet to be used. According to OSHA there are 3 types of helmets, one is class G, other one is class E, and a third one is class C. Class G is for general service which implies for any bumps onto the structure or any obstacles or any protrusion in a particular site.

It can provide good impact protection, that is primarily class G. Class E helmets are generally for electrical work, protect against falling objects and also against shocks and burns. Class C is

designed for comfort, so which protects workers from bumping and also limited protection against falling objects and electric shocks.

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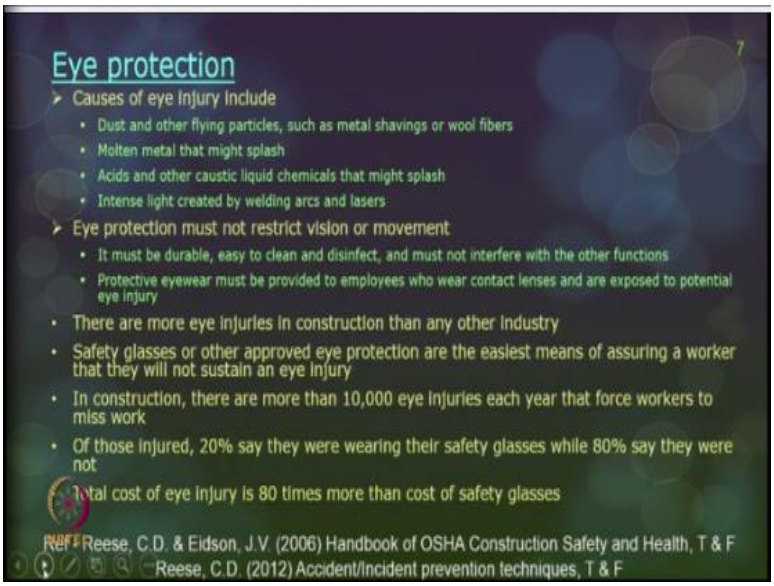

The next is eye protection. So, the causes of eye injury, what all can create damage or what are all hazards to an eye? Dust or any flying particles such as metal shavings are wool fibres, molten metal which can splash especially when you are doing welding you maybe actually burning a metal and this molten metal can splash acids and other caustic liquid chemicals which can again splash.

An intense light created by you were rebuilding arcs and lasers can be really dangerous to the eyes. So, eye protection, the choice of eye protectors must not be restricting your eye movement or the vision of the eye. At the same time the protectors should be durable, should be easy to clean, you should not interfere with other functions. And also, protective eyewear must be provided to employees who already have a lens for corrective measures to the eye.

So, if you see here again there are so many eye injuries which are reported in construction than any other industry. Especially most of these injuries have happened because of welding and other related operations, welding and laser operations. So, almost 10,000 eye injuries are reported each year, that is not one of the statistics says. And if you see here of those who were injured 20% of

them were wearing their safety glasses and 80% of them did not even have a proper eye protector in place.

So, compensation paid to an eye injury is almost 80 times more than the cost of a pair of safety glasses. So, better go for an eye protector rather than paying on a compensation for eye injuries.

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So, what are the different eye protectors? Let us go with the terminology, so what is an eye protector called? It is any form of equipment which includes a lens and worn in front of the eyes to provide protection to the eyes. And what is an ocular? It is a lens, it is that part of an eye protector through which an operator can see, that is primarily called us an ocular. And there are different types of eye protection are goggles, safety spectacles.

Then you have face shields and the hoods and other varieties are there, primarily it comes under shields. Goggles, again goggles they are so many varieties of goggles, so what is a goggle? It is an eye protector which protects the eyes, eye sockets, the facial area also which is immediately close to the eyes. And protects the eyes from any impact dust, splashes and is helding position into the eyes with the help of a headband**.**

This is primarily what is called goggles**,** this picture will show you what is a goggle. Now next is cover all goggles, so this is primarily over and above your normal glasses you can wear these

goggles. This is primarily called cover all goggles, it is designed to fit over vision correcting spectacles. Next is dustproof spectacles, so these goggles are designed to restrict the ingress of dust into the any orbital areas of the eye**.**

And this generally comes with the side shields and also it comes with top shield**,** so that the eyes are completely enclosed without any dust entering in the eyes. The next is eye cup goggles and as the name implies, just on it looks like a cup and there are 2 eye protectors which is the figure is shown here. An eye protector consisting of 2 lenses mounted on 2 separate cups, and you have an adjustable nostril, flexible nose bridge and it also has a headband**.**

This again there are a lot of varieties are here also. The next one is gas tight goggles, they are designed to prevent ingress of harmful gases and fumes and entering into the eyes. So, these are all the different varieties of goggles available for workers to use. The next one is safety spectacles, so eye protector along with the oculus which is mounted in a special type frame, it comes with or without side shields.

So, these safety spectacles can come without the brim and the side shield, it can come in any forms. Next is filter, sometimes you also have a filter and through which you can see the objects properly and the filter can come in so many varieties**.** An ocular designed to reduce intensity of the incident harmful radiations by absorbing only few of the radiations and then reflecting many of them.

That is primarily called filter, it can be in plastics, it can be in solid glass, it can be in laminated construction or other suitable material. And filter cover, so whenever you are using your filter there should be a filter cover. This is a transparent cover used to protect the filters against abrasion and weld splatters. So, generally these are used while welding and laser cutting operations**.**

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Primarily when you are using steel construction, PPE is used for welding and laser cutting operations. Next, we are going to little see on shields**,** shields again one is eye shield other one is face shield. Eye shield, a transparent visor supported in front of the face to shield the eyes. The face shield, it is a device including a transparent visor supported in front of the face which can shield the eyes, face, forehead, front of the neck and so on.

So, this picture is primarily the face shield with the COVID situation I think many of you will know what is the face shield all about. And the face shield extends from the brow to below the chin across the entire width of the employee's head and it is polarized for lab protection sometimes you can also have different varieties there. It generally protects against corrosive chemicals, splashes and so on.

And it is used while grinding, chipping, cleaning wells or around flying particles to safeguard your face. Then next is laser safety goggles, it provides a range of protection against intense concentrations. So, you can either have a variation through wavelength or it can be variation through lenses accordingly you can safeguard the welding and also the laser once. The next is safety clip on, so this is primarily a safety clip on, you only have a lens which can be fixed over your regular spectacles and which can protect your eyes.

The last one is hood, hood and all are used while you are using welding, primarily in steel construction. It is a device used to cover completely head, neck, face and so on, and leaving a small lens for your eyes otherwise it covers your whole upper portion of your face and body, and all these we will discuss while we are doing on welding.

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Otherwise, we have welding helmets, welding hoods and so on, welding shields and lot of varieties are there. So, what about this eye protection? So, what are the different hazards and what PPE is recommended and as given in IS codes. So, impact, for any impact hazard sources can be chipping or grinding of metal, stone dressing, turning off cast iron and so on. So, PPE recommended is safety spectacles with side shields or you can go for a cup type goggles or complete face shield is also fine.

When in there is a dust hazard, sources are from sealing or grinding handling of cement clay etcetera. Primarily when you are working on concreting activity with the usage of cement, it can be cement, paste cement mortar concreting you will have dust. You can go for dust goggles or you can have a complete face shield also. Splashes from metals, pouring of lead joints, die casting, dipping in hot metals, foundry work and so on.

Again, you can either go for cup type goggles or you can go for face shields. Splashes from liquids, so handling of acids, alkalis and other similar chemicals you can go for a complete face

shield. Reflected light and glare, primarily while testing of lamps or sheet metal, lathe work and so on, either you can go for safety spectacles with side shields or you can go for cup type goggles.

Radiant energy, primarily when you are working on oxy acetylene welding, cutting, furnace works, electric arc welding, primarily the types of welding, you can either go for welding hoods or welding shields or you can also go for cup type goggles, face shields or face safety spectacles with side shields.

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So, we have talked about eyes, and we have also talked about face shields, let us talk more about face protection. So, there are so many types of face protection, face shields without a crown protector which implies it only covers eyes and the portion below. So, this is primarily a face shield without a crown protector. Face shields with the crown protector wherein it covers your forehead as well and then a front part to cover your face.

The next is face shields with the provision to attachment to your safety helmet, there also you have 2 varieties, one is to your full brim helmet and other one is your brimless helmet. So, you can primarily attach to a complete helmet. So, it actually covers your head and face completely, it protects your head and face completely.

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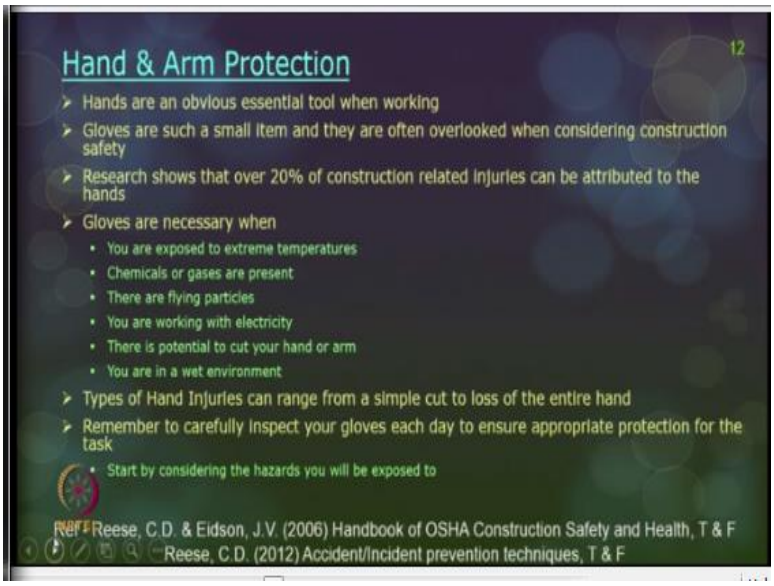

The next is hand and arm protection. If you look at many of the organs, hands are an obvious tool while working, most of the workers use hands, without hands they may not be able to do any work in the construction site. And if you see on the other extreme, gloves are very small item and which is often neglected in any construction site when it comes to safety because workers try to handle something with the bare hands.

So, gloves are least often preferred in the construction site and hands are the essential tools when it comes to working in a construction site. The workers feel they lose their grip when they are wearing the proper gloves. And the research shows, 20% of construction related injuries are attributed to the hands and gloves are necessary under certain situations. Number one, when you are exposed to extreme temperature or when there are chemicals or gases are present.

When there are flying particles, when you are working with electricity, there is a potential to cut either your hand or your arm. And you are working in a wet environment better to choose a pair of gloves. And types of hand injuries which were reported so far can range from a single simple cut to the loss of a complete hand**.** And also remember to choose the right gloves for you because there are so many types of gloves available, and for so many hazards which are existing there.

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Now let us talk about fabrics with which the gloves are made. One is metal mesh, leather or canvas gloves, second one is fabric coated gloves, the third one is chemical and liquid resistant gloves and also, we have something called as synthetic gloves. So, these are the different varieties of gloves and the picture shows you the different varieties. Now first one let us talk about is metal mesh leather or canvas glows, it is a sturdy provides protection against cuts, burns and sustained heat.

And this leather can protect against sparks, moderate heat, blows chips or rubber objects. And there are other types of metal mesh gloves primarily called aluminized to gloves or aramid fiber gloves. So, these aluminized gloves are used for welding, furnace and foundry work, aramid fiber gloves are primarily used and when you are working for synthetic materials and protect against heat and cold.

The next is fabric and fabric coated gloves, primarily protection against dirt, dust abrasions. And the cotton fabric coated gloves with plastic and provide protection against the slip resistance. The next is chemical and liquid resistance, so this material is primarily of rubber plastic or synthetic rubber like material. It protects workers against burns, irritation and dermatitis, and there are special varieties of rubber gloves which will also protect against acids.

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So, these are the different types available.

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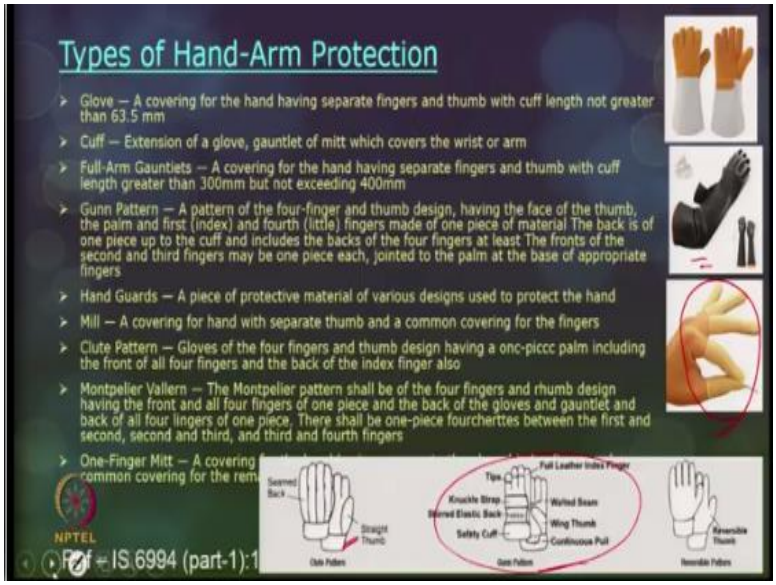

What are the different types of hand protection? It starts from just a single finger protection to the complete hand protection, there are a lot of varieties available. And there are lot of terminology also available as seen in the IS code. So, first gloves, I think most of you know what is a glove, it is a covering for the hand having separate fingers and thumb and the cuff length is not more than 63.5 mm.

So, this is primarily called cuff length and this cuff length is not more than 63.5 mm. Then what is a cuff, it is an extension of a glove which covers the wrist or the arm. And the next one is full

arm gauntlets, so primarily it covers your full arms, you would have seen people wearing when they drive, 2 wheelers, that is primarily called full arm gauntlets which is like this.

This is a covering for the hand having separate fingers and thumb separately, and with the cuff greater than 300 mm but not exceeding 400 mm. So, between 300 mm to 400 you have a longer cuff and that is primarily called full arm gauntlets. Next is gun pattern, it is a pattern of forefinger and thumb design, having the face of the thumb the palm and the first and the last finger made of one piece of material and you have another piece of material on the back.

So, you have so many designs coming in. So, this picture is primarily a gun pattern one. The next is hand guards, so this is a piece of protective material of various designs used to protect the hand, it can be worn over and above your gloves or your cuffs. The next is mitt; it is a covering for the hand leaving separate for the thumb and one common covering for all your 4 fingers. So, it has only 2 partitions one for the thumb and one for all the 4 fingers.

Clute patterns, so clute pattern is something like these gloves of 4 fingers and thumb design having one piece palm including the front of all 4 fingers and the back of one index finger also, so it is like continuous strips like that. Then Montpelier pattern, so this pattern shall be of 4 fingers and thumb design having the front and all 4 fingers are one piece. Back of the gloves and the gauntlet of all the back fingers are of one piece, that is how it is.

One finger mitt, covers the one particular finger which is supposed to be which you think is hazardous, which is something like this. So, you can actually use just a covering for just for one finger alone, that is primarily called one finger mitt.

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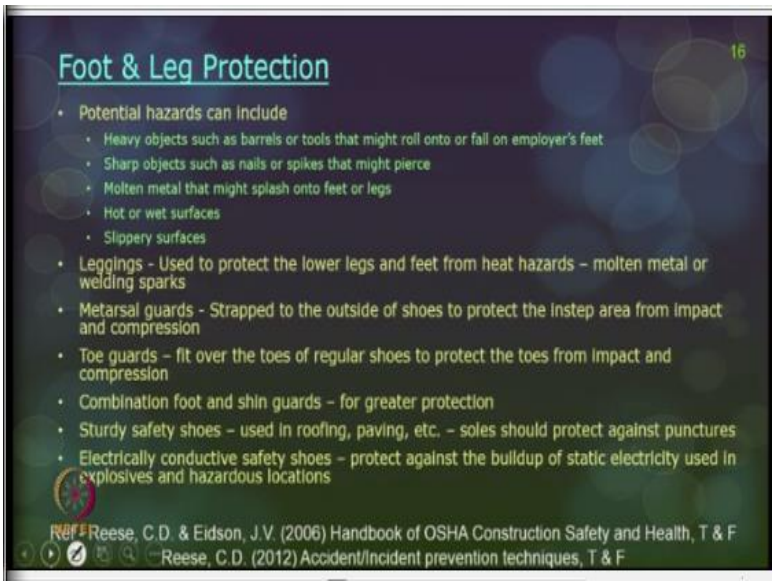

The next one is foot and leg protection. So, when you should go for foot and leg protection? So, heavy objects such as barrels or tools that might roll on or fall into a worker's feet. Sharp objects such as nails or spikes which might pierce and penetrate into your legs, molten metal, that might accidentally splash on your feet or legs especially when you are working on hot or wet surfaces or maybe on slippery surfaces, you should go for a proper leg protection.

Again, the leg protection is of so many types. Number one is leggings, leggings then you have metarsal guards, toe guards, combination of foot and shin guards, sturdy safety shoes and electrically conductive safety shoes.

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So, the pictures are like this, a legging it protects the lower legs and the feet from the heat hazards such as molten metal or welding sparks. Metarsal guards can primarily protect you from any impact and compression. So, it primarily protects the middle portion of your legs. Next is toe guards, it only helps to protect your toes, impact from any compression or any hazard primarily onto the toes it only supports.

So, over and above your shoes you wear all your toe guards, and over and above your shoes you wear the metarsal guards. The combination of foot and shin guards, it protects on lower legs and the feet and may be used in combination of toe guards when greater protection is needed. When your full leg protection is required then you have to go for full-length boots and the shin guards.

The next is safety shoes, safety shoes are supposed to be impact resistant, heat resistant soles and the soles which implies the bottom portion of the shoes should be very sturdy and you should be able to resist impact and heat. And the shoes maybe also be designed to be electrically conductive especially when you are working with electricity. Now so these are the different types of leg protection. The sturdy say safety shoes are primarily used in roofing, paving works and so on.

And the soles should protect the workers against punctures, cuts, any protruding hazardous objects and so on which is available in the construction sites**.**

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Types of footwear, there are so many types of footwear. For example, low shoe which is primarily just at a very low height you get a low shoe. Next is ankle shoe, which is the normal shoe which you wear which is comes at the shape like this. Half knee boot, so this is primarily like this**,** then full knee-high boot, so knee high boot it stops till your knee level and then you have this. And the thigh boot it actually extends above your knee, this is your knee it extends above your knee and it covers your full thighs.

So, these are the different types of footwear available. And as regard to footwear, there are so many IS Codes available on specifications, special types of places, for example steel plants, how to maintain, how to test, there a lot of testing procedures also available on footwear, if you are interested you can go through the other IS codes. Next, we will talk about the full body protection, it talks about clothing, clothing we will discuss next, first we will talk about the apron.

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So, apron again there are so many types of aprons, starting from bib type, waist type and so on, so we will discuss one after the other. First one is bib type, so bib type this is a picture of the bib type, it covers the chest, waist legs and so on till the knee, sometimes even till ankles it can be full length a bib type also. The other one is waist type, so which is like this, it covers waist and the legs down till the knee sometimes even below that also.

Split type, split type is usually used by workers when they are working on building operations**.** As the name implies, it has split only for the legs and you can fasten the apron onto your legs, divided at the crotch level and fastened around each like that is primarily called a split type. Cape sleeve, so this is primarily a picture of cape sleeve, so this cape sleeve can be worn on to your regular aprons, it is primarily an additional protection to your back, shoulder and arm covering which extends over the upper chest.

So, this is actually like an overall onto your regular aprons. The next one is overall, it is a one piece apparel which completely covers top to bottom, the whole body of an worker which includes pull on pants, upper portion covering the body, hands also partially or completely, it depends on the type of overall. Next is jacket, I think jacket is known to many of you it covers upper body from shoulders to hips.

The next is coat, so this is a picture of the coat it extends either to knee level or ankle level to give the full body or leg protection as well. The next is suit, suit is generally a covering from head to foot and generally the suit also has respiratory protection embedded with. So, clothing, protective overalls are used by every 4 out of 10 workers, and the other 6 out of 10 workers they claim clothing is not the clothing what is expected to be worn in a construction site is not they are not comfortable.

Because either of the warm weather or it is irritating or itching when especially when they are working on something, so as a result they do not do a proper overall itself.

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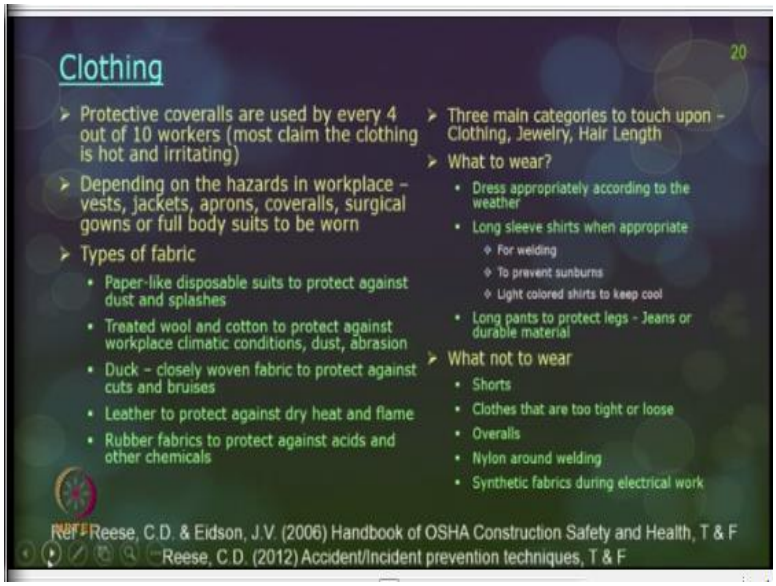

Depending on the hazards in workplace you have to have additional covering. For example, it can be jackets, it can be aprons, it can be overalls, it can be surgical gowns or can be full body a suit also has to be worn. If you look at the type of fabric with which all these full body protection comes in, it starts from paper like disposable suits, treated wool and cotton and then leather material, rubber or plastic material also, it comes with different material as well.

So, paper like disposable suits are primarily used again dust and splashes. And treated wool and cotton are used to protect against workplace climatic conditions, cotton for hot summer and woolen for cold weather and also against dust an abrasion. Duck, duck is nothing but a closely

woven fabric which is primarily used to protect any cuts and bruises. Leather material is used to protect against a dry heat and flame, rubber, primarily for acids and chemicals.

So, your choice of fabric and the type of fabric as you have seen earlier, you have to mix and match and then choose the right clothing for the hazard. Now when you talk about clothing, there are few things which generally safety researchers stretch up on, one is clothing the actual clothing, the next one is jewellery and hair length**.** So, you should not be wearing any loose clothes which enters a machine or machinery and so on.

And jewellery should be avoided and also the hair length is there it should be properly held in place. What to wear dress appropriately according to the weather and also to shoot the hazard and do not primarily you should wear a long sleeve shirt especially when you are working in hot summer and also when you are doing welding operations. And long pants especially when you are working with durable material especially when you are working with, all these destined areas of pollution.

So, what not to wear? You should not wear nylon clothes when you are working near welding, you should not choose synthetic fabrics when you are near electrical work.

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Then types, so leather clothing, asbestos clothing, flame proofed fabrics, chemical resistant clothing and rubber clothing, how to safeguard? So, leather clothing makes you safe against water, oil, acids etcetera. Asbestos clothing, so it actually protects you from dust and other pollutions, you can wash asbestos clothes in warm soap water. But you should also keep in mind it is start shrinking while you are washing, so you have to make sure that the asbestos clothing is properly maintained**.**

And you are not tearing it or crushing it while handling and using it. Flame proofed fabrics, so flame proofed garments are usually made from cotton impregnated with the flame-resistant chemical solutions. And often the cleaning of garments maybe through pains or oil or grease, it should be you know it should be properly cleaned of from the garment and by dry cleaning. After dry cleaning the garments should be tested for their strength and resistivity and then only it should be used against for the next round of work.

Chemical resistant clothing, it protects against acids, solvents, caustics and similar materials primarily it is embedded (41:37) or coated with plastics are used along with the garments when you are working with the chemical resistance clothing and when chemicals have been splashed you should wash it very carefully. Rubber clothing, it helps you to protect against excessive heat and mechanical damage.

So, avoid exposure to direct sunlight otherwise the rubber quality may go torn, cut or scratched or it may be worn out with direct sunlight. So, avoid crushing or squeezing it as the quality of rubber will go off. And when wash and dry thoroughly before storing it and you should also warm dry before you are storing a rubber clothes.

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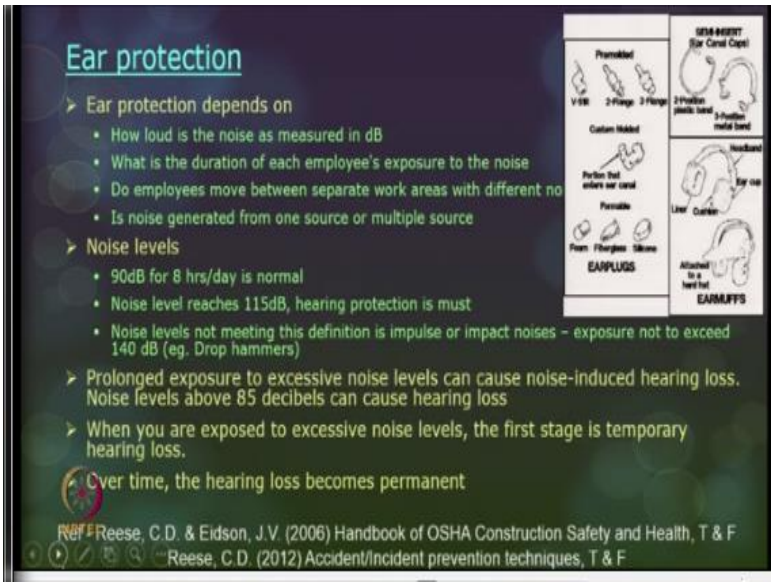

Next is ear protection, so ear protection depends on how loud is the noise as measured in decibels**.** So, this ear protection we may also discuss along with health hazards. So, what is duration of each employee's exposure to the noise and do the employees move between workplaces which has less noise level to your workplace with more noise level or they frequently moving on in a site which has varying noise levels.

And is a noise from one source or is coming from multiple sources and from what different timings to what different timings or these depends on what ear protection you may have to choose. Now what is mean by noise level and what is the expected noise levels. So, 90 decibels is the maximum noise level you can hear, for 8 hours a day and it is considered as normal**.** And if the noise level reaches 115 decibels, then you have to go for a hearing protection and it is very compulsory.

And the noise levels which is going above this primarily to 140 decibels or something then we call that as an impact noise or an impulse noise example can be drop hammers when you are doing piling works. So, prolonged exposure to excessive noise levels can actually cause noise induced hearing loss. And if you do not take proper precautions and protect your ears with the PPE over and time period you may your hearing loss will become temporary.

And then first stage and overtime it will become permanent**.** so, the different types of ear protections start from ear plugs pre molded, molded, custom molded there are so many varieties available. And also, to earmuffs and sometimes it can be an attachment to the safety helmet also or with a headband. So, plain cotton as a precaution for the ears against noise levels, is not sufficient.

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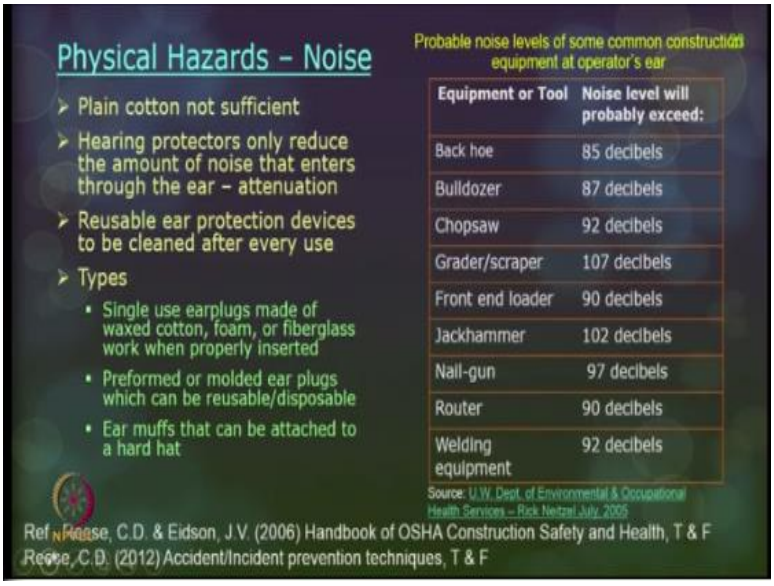

And workers sometimes do think cotton keeping a bunch of cotton is enough which is not at all sufficient for the hearing which is going on in the construction sites, hearing protectors only reduce the amount of noise that enters through the ear and it does not completely put of the noise which is going into your ears. Suppose if you are thinking of a reusable ear protection device then you should be cleaned after every use.

Since ear is a very sensitive organ most of the time the ear protectors are generally single use ear protectors only. Types of ear protectors, it can be single use ear plugs which can be made of waxed cotton, foam or fiber glass or preformed or molded ear plugs which can be again reusable or it can be disposable. Earmuffs which come separately with a head band or it can also be attached to your hardhat.

Now let us talk about noise levels in a construction site, if you see different equipments available in a construction sites most of these equipments generally produce sound above 80 decibels only.

This is also given from one of the environmental and occupational health services department. So, backhoe 85 decibels, bulldozer 87 decibels, chopsaw 92 decibels, grader or scraper 107, front end loader 90, jackhammer 102, nail gun 97, router 90, welding equipment 92.

So, almost day to day operations if you see every operation has one equipment or more than one equipment which will leave noise which is beyond the permissible limit. And even if an operator is actually hearing all these noises, all the workers who are working near that particular equipment also will be hearing that same noise levels and it is recommended even for the others to wear.

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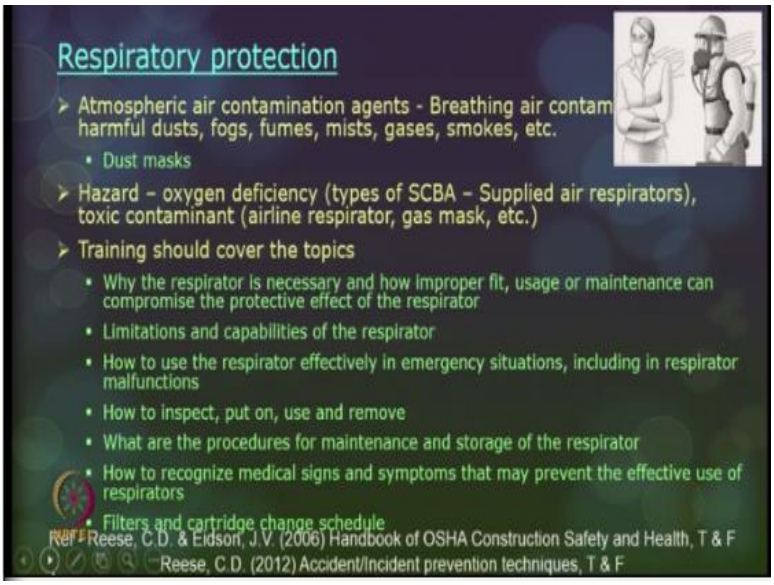

The next comes respiratory protection. so, this is primarily for confined spaces, you in confined spaces you may not have either good amount of oxygen or little surplus amount of oxygen. So, in those places or maybe even harmful gases may also be present along with the chemicals and other toxic fumes and vapors. So, you may have to have a respiratory protection if you are working in those places.

So, atmospheric air contaminant agents, it can be through breathing, you maybe breathing harmful dust, fogs, fumes, mist, gases, smoke etcetera. And when you have a normal contaminant, you can go for a dust mask which is an ordinary mask which we use these days.

And when there is a hazard level with oxygen deficiency and so on. Then you may have to go for a specialized SCBA protector which is nothing but supplied air respirators.

And when you are having a toxic contaminant then you may have to go for an airline respirator or a gas mask and so on**.** And whenever now respiratory protection is very serious and during the training itself you should be giving adequate training to the workers as to how to inspect their respirators and how to use a respirators and what should they do when something goes wrong and so on.

And first number one training should cover the following topics, why the respirator is necessary? And how any improper fit usage or something can actually compromise the protective effect of respirator. Then what will happen even though you wear a respirator it is not going to protect you at all. So, limitations and capabilities of the respirator also the training should be covering upon.

And how to use a respirator effectively in emergency situations, including respirator malfunctions. Suppose you have entered a confine space and the respirator has got a malfunction, you should know how to come out of the emergency situations and move out of that place. Then how to inspect put on, use and also remove and keep away your respirators all these should be covered in the training programs.

And what are the procedures for maintenance and storage of the respirator? How to recognize medical science and symptoms that may prevent the effective use of respirators? Suppose you have some medical history or something then how safely you can use respirators and so on. First of all, it should be understood by you then only you should be thinking of respirators. And whenever you are using respirators the last thing you should know where are the filters, how to use the filters and how you should change the cartridge change schedule. That also you should be aware of and you should be discussed in the training programs.

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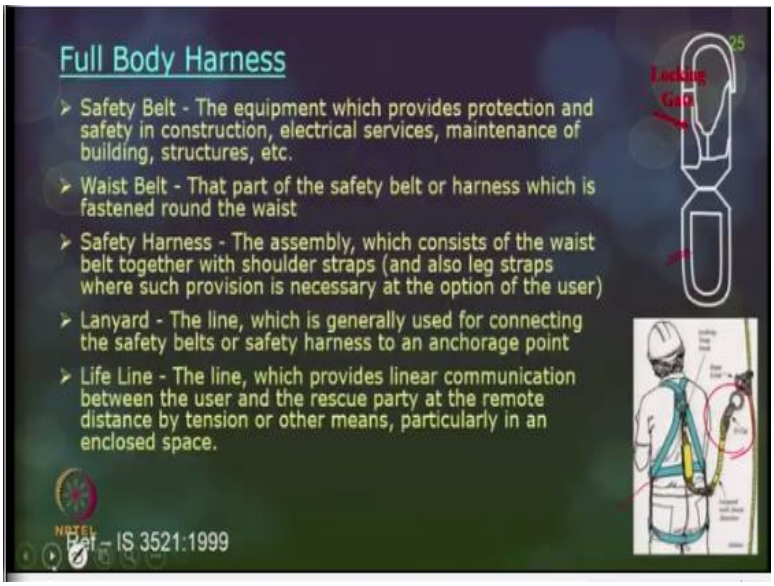

The next topic is full body harness, so when you talk about full body harness primarily with a fall hazard you have a danger of falling from heights and this full body harness is there. So, when I discuss on fall hazard, we will be discussing this depth but it is primarily a part of a PPE, so I will be little covering on what is a full body harness? So, full body harness there are some terminologies available on full body harness, one is safety belt.

It is an equipment which provides protection and safety in construction, primarily for working in construction, maintenance, operation work, electrical services and for any maintenance of structure, building and so on. There are lot of issues for which you may have to go for a safety belt. And the next one is waist belt; this is a part of the safety belt or harness which is fastened around the waist.

The next is safety harness, it is a complete assembly which consist of waist belt together with shoulder straps or also leg straps based on the type of safety harness. So, this is a picture of a full body safety harness. The next is lanyard, so this is a line which is generally used for connecting the safety belts or safety harness to an anchorage point**.** This anchorage points are the fixed points or maybe it is supposed to be the load bearing point from where you may be falling of whenever there is a fall happening.

Life line, so the line which provides a linear communication between the user and the skew party and at the remote distance by tension or other means particularly in an enclosed space**.** So, maybe even a worker is actually in an enclosed space or something then you should actually have a full body harness or a life line for the worker to go. And these life lines are the means of communication at those times for the people outside for the workers to communicate with the workers who are standing outside the confined space**.**

Now this is primarily called D-ring or the D-clip, D-clip is very, very critical**,** so this D-clips itself should be able to support 5000 pounds at least**.** So, failure in the D-clip primarily the worker will die**,** so this D-clip based on the choice of these D-clips.

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There are so many types of body harnesses available**.** So, number 1 is class A harnesses, class A harnesses are designed to support the body, during and after the fall, so this is a normal one and this will have one D-ring for the fall arrest attachment, affix to both the shoulder straps and at the back or at the front. The next is class D harnesses are designed for controlled descent from a height and this will have front or side mounted D-rings.

Class E harnesses are designed to support the user for entry and exit into confine spaces. This will have a sliding D-ring on each shoulder strap. Class L harnesses are designed for ladder climbing and this will have 1 or 2 D-rings attached to the front of the harness. Class P harnesses

are designed to position the user during a work operation and this will have D-rings mounted at the waist level primarily for work positioning.

If you see here, this is a dorsal D-ring, this is a frontal D ring, this is a side mounted D-ring and this is a shoulder D-rings**.** So, these are the different positions on the D-rings and accordingly you have too many types of body harnesses to protect the workers against a specific hazard**.** So, wrapping up so these are the different types of PPEs available, so you have to encourage the workers to use the PPEs.

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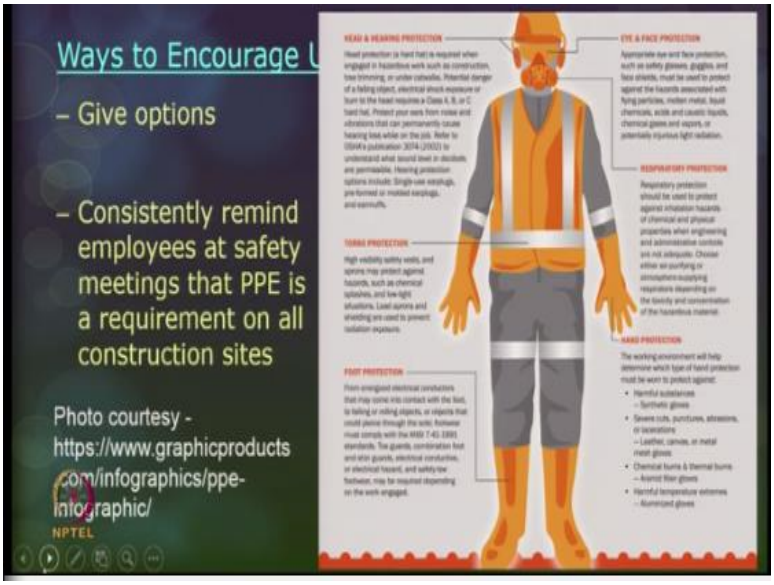

The way of encouragement is do not be giving them a same color of the cloth for an apron or something where it looks like an uniform. You can have choice of colors, choice of designs even for the safety of eye protection you can have choice of different colors or spectacles and so on. So, that the workers will be willing to come forward to use those based on their taste and the type which is required.

And consistently remind the employees at safety meetings that PPE is a requirement on all construction sites**.** So, what are the different sites we have learned today, head protection, head, hearing protection, eyes, face protection, respiratory protection, we have also learned about hand and arm protection, foot and leg protection, overall body clothing and also the full body harnesses.

And we will be learning about torso protection that is primarily a visibility safety vest and aprons which is primarily to give some signals or communication to the workers. And the lead aprons and shielding are use to prevent against radiation exposures.

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These are different things we have seen earlier and last but not the least, so PPE is used to protect the workers but it does not mean hazards are removed. Hazards are still there, so PPEs will help you to escape from the hazard or at least have a minimum impact on the hazards. If you look at so many infographics on PPE lot of statistics are available on the number of injuries which happen with regard to either wrong usage of PPE or maybe not using a proper PPE at all**.** If you see here many of the hand, arm, head, eyes injuries all have happened because of improper use of PPE or lack of usage of PPE.

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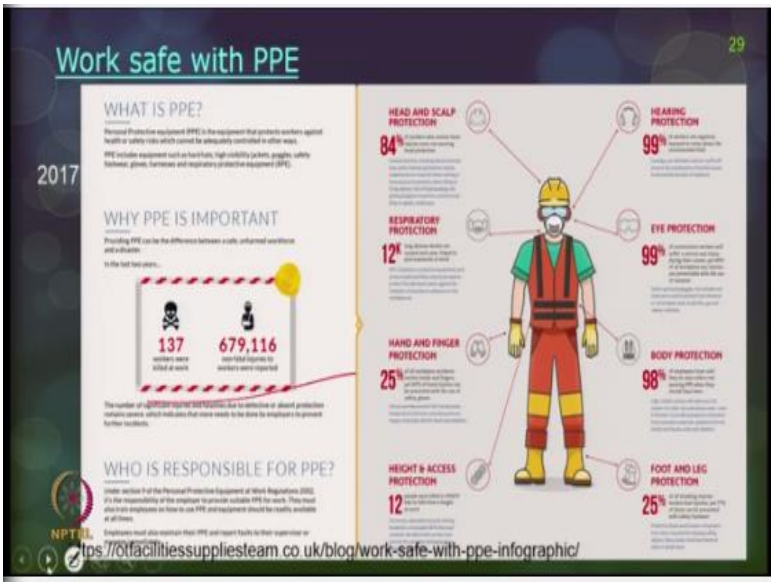

So, this is also from 2017 which says 137 workers were killed at work and almost like 6 lakhs of people suffered with non fatal injuries because they did not wear a proper PPE. So, PPE is very important to work in construction site.

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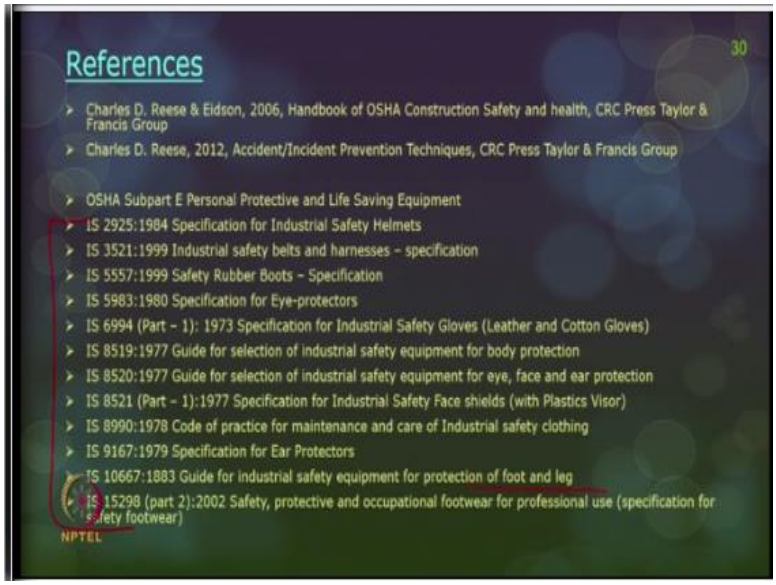

So, with this I will close for today's topic and before that these are the different references from where this particular lecture was taken up. If you see here there are so many IS codes from where I have collected all the material and especially for foot and legs, there are lot IS codes available. Thank you.