Principles of Construction Management
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Lecture – 22
Accidents in construction industry – I

[FL] and welcome to the series of lectures on Principles of Construction Management. We start a discussion in a module relating to Construction Safety on what is the importance of safety, and why should a construction manager be very well versed with the issues that go to prevent accidents. And the discussion today is focused on some examples which are extremely relevant as far as accident prevention in the construction sector is concerned that is accident prevention at construction sites.

Now, as I have said in the introductory lecture in this module that Construction Safety and Construction Quality or perhaps 2 areas, which are not given the due place as far as instruction in construction management or project management is concerned in a word civil engineering curriculum reasons for that could be very many including the lack of the right information as far as academic institutions of people what teaching academic institutions is concerned.

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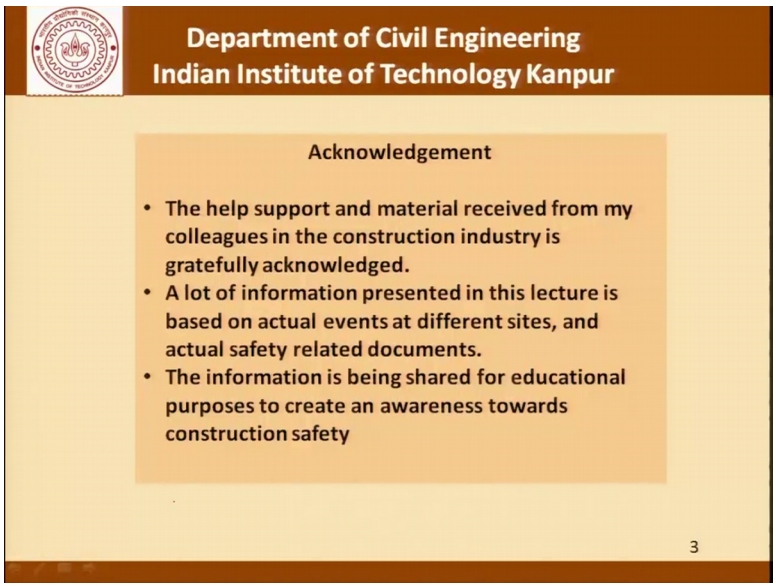

So, far this module especially relating to construction module I would like to actually acknowledge the help, support, and the material which I have received from my colleagues in the construction industry and that is indeed extremely grateful acknowledged. A lot of information presented in this lecture and the next one and perhaps in this module is actually based on actual events a different sites, and actual safety related documents of different construction companies.

So, the information is being shared for educational purposes to create an awareness, towards construction safety and enable the students in civil engineering and related feels to be aware of the different issues that going to construction safety. In the spirit of the disclaimer given in the document which I shared with you from the occupational safety and health administration though effort has been made to acknowledge the help and the specific details from the sites and from the literature wherever possible at times it may not have been possible, but that is in advertent.

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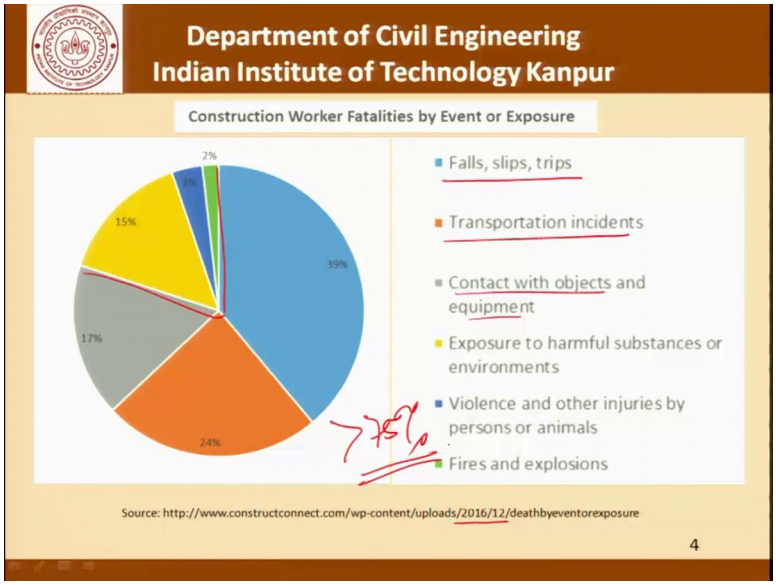

Now, moving on to the statistics relating to construction worker fatalities by events or exposure we find that this pie chart tells us what is the nature of accidents leading to fatalities as for as construction sites is concerned and that is the data which has been uploaded apparently for 2016. Falls, Slips, Transportation related accidents, Contact with objects and equipment, Exposure to harmful substances or environment, Violence or other injuries by persons or animals, and Fires and explosions. If you are somehow able

to take care of falls transportation related incidents and contact with objects in equipment we would be able to take care of more than 75 percent of the construction worker fatalities and that is indeed a very very large number.

We have already gone through the statistics a little bit in the last class and this really shows the importance of handling construction safety at site at the root level.

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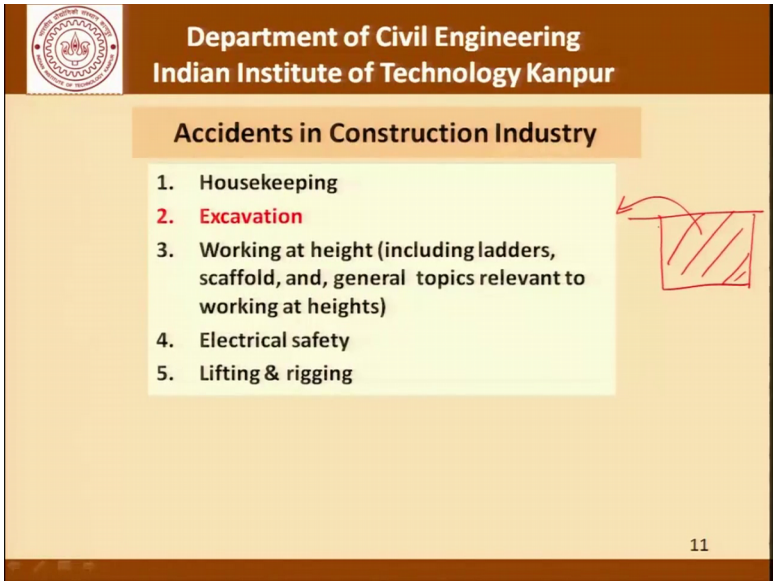

Discussion in our lecture today would be relating Housekeeping to the accidents in the construction sites, Excavation related issues, Working at height which includes ladders scaffolds, and general topics relevant to working at heights, Electrical safety, Lifting and rigging and Special Topics, which is in red because we are not going to talk about it today, but in a subsequent lecture.

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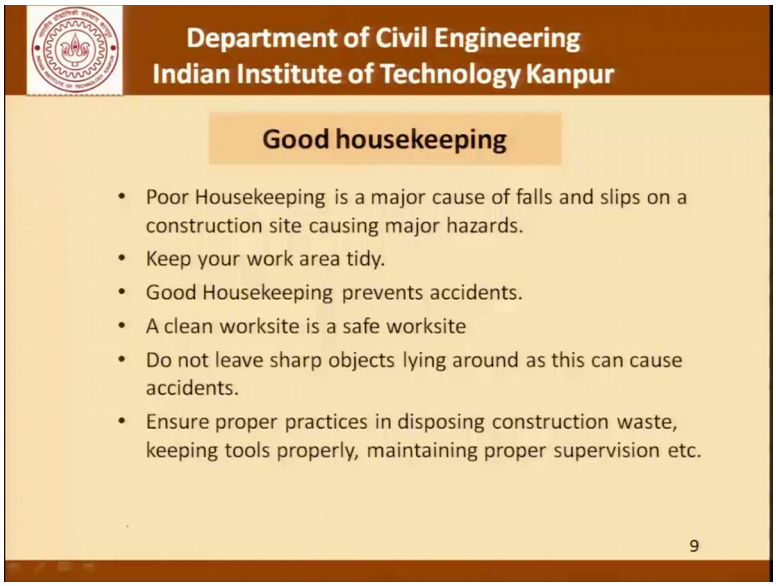

So, coming to the agent of today's discussion which is these 5 topics let us come to the first one housekeeping. Good housekeeping essentially involves keeping the construction site clean, it is a major cause for slips, falls in the construction site and is a major hazard. It is important that the work area is kept tidy.

Good housekeeping prevents accidents and a clean work site is a safe work site does not leave sharp objects lying around as this can cause accidents and ensure proper practices in disposing construction waste keeping tools properly, and maintaining proper supervision.

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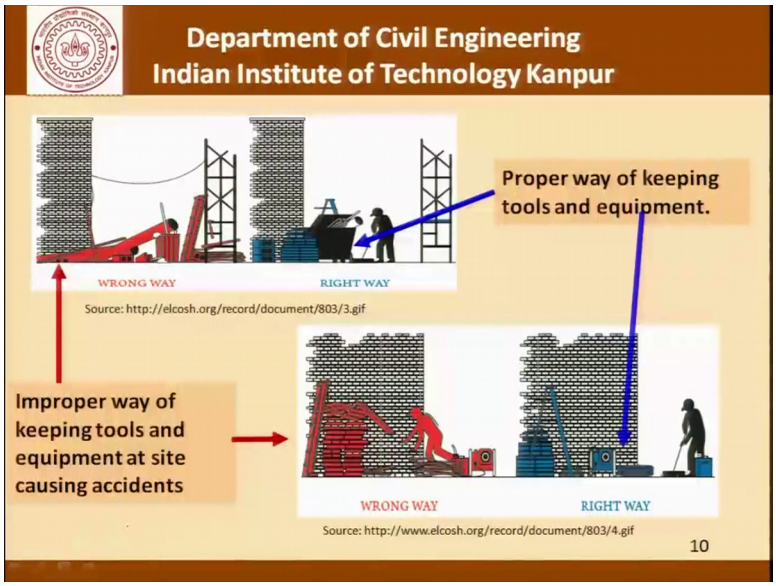

These are examples of Proper and Improper ways of keeping tools and equipments at construction sites. We see here that the site is, so much more clean and this place is a cluttered site; a cluttered site is a very very difficult site to navigate and is the cause for accidents.

So, that is what we mean when we say Good Housekeeping is a very important part of construction management it must be ensured that the sites are kept clean parts of his scaffolding, reinforcing parts, bits and pieces of concrete aggregate kneels these should not be allowed to be spread all over the place. There needs to be a proper cleaning that has to be ensured especially in areas where people are walking more frequently.

In cases that it is impossible to do that at a particular point in time those area should be barricaded and I am going to show you some photographs of a real site where this has been ensured. So, moving forward coming to Excavation what does Excavation mean? Excavation means that as far as a ground is concerned we remove a part of the ground. This removal of earth and it is deposition somewhere is basically what is excavation. So, what are the kind of issues that are involved as far as construction safety is concerned relating to excavation work.

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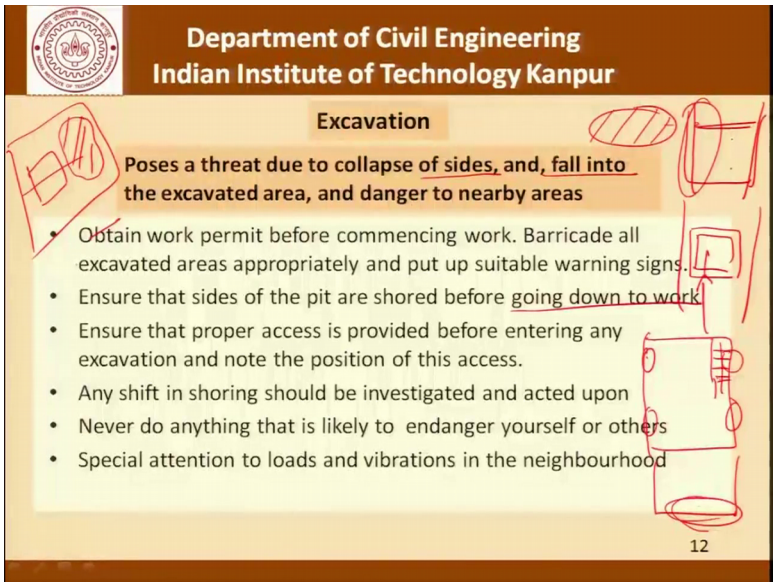

Excavation poses a threat to the collapse of sides, and fall into the excavated area, and danger to nearby areas. As for as the collapse of sides is concerned the explanation is simple that if we excavate this area, whether this sides should be vertical, or they should have a certain slope, depends on the type of soil, depends on the depth of excavation, whether the soil is wet or dry the groundwater table and so on.

All these things put together help us evaluate the threat arising out of collapse of the sites. Fall into the excavated area basically means that if at a construction site we have created an excavation here, then unless this area is barricaded somebody walking here can just fall into this excavated fit it could happen to a person or it could happen to an equipment. As far as danger to nearby areas is concerned the issues the following.

If at a site we are carrying out excavation here we have to be careful that this area here, which might already have some construction work that might get affected because in this part we are going to remove the earth. Portion here which may have some construction already existing this might be affected because we have remove this earth.

The issues relating to overburden and so on have to be also born in mind by the safety personal at the site. It could not danger this building; it could not danger this building or it could trigger a collapse of the side. So, coming to what are the kind of options, what are the kind of measures that need to be taken as for as excavation related issues is concerned the first thing that comes to mind is obtained work permit before commencing

work barricade all excavated areas appropriately and put up suitable warning signs. Ensure that the sides of the pit are showed before going down to work shoring refers to any kind of means that is adopted to hold this phase firm. And this is a plate or it could be something else which is driven into this ground, so that this failure of the slope is prevented.

Now, how to we ensure that this shoring remains in place that depending on the depth of excavation involves putting up struts such as this. We must ensure that the shoring and struts and whatever means have been taken is in place and not showing any signs of distress before a worker goes down to work. The work actually happens at the bottom of the pit and before we get into the pit we must ensure that the shoring is in place and is healthy. Ensure that proper access is provided before entering any excavation and note the position of this access. If you look at an excavated pit in plan if this is the section. In order to be able to access this area very of 10 we create steps in this part of the pit or we provide ladders at different places to lower the workman into the pit.

Those ladder should be in place and the workman should know that those ladders have been installed and her safe. Any shift in the shoring should be investigated and acted upon it is possible that the shoring that has been provided on the sides is distressed on account of the side pressure from the soil it could happen for whatever reason, but the point is that as far as excavation in the pit is concerned if any shift or distress in the shoring is noticed it should be acted upon before continuing with the excavation. Never do anything that is likely to endanger yourself or others. Special attention should be paid to loads and vibrations in the neighborhood; we have talked about this a little bit earlier. That if there is some activity in the neighbourhood here that could also cause distress to the excavation depending on it is depth and other factors. And while this excavation is going on it should be ensure that vibrations and loading in neighbouring areas is also controlled to the extent possible.

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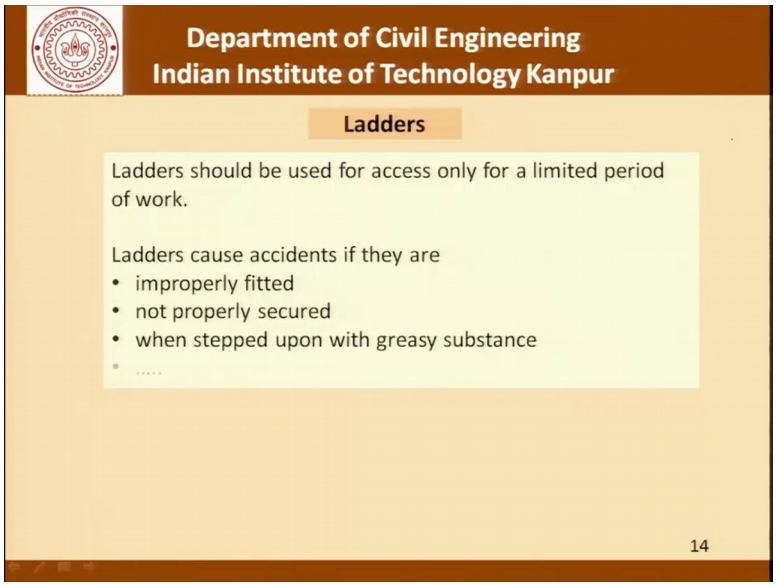

Now, moving on let us talk a little bit about working at height which includes Ladders scaffoldings and other topics; coming to Ladders first this should be used for access only for a limited period of work, it should not be made a practice that work at a certain height is carried out with the workman on the ladder for long periods of time. Ladders cause accidents if they are improperly fitted, not properly secured, when stepped upon with greasy substances, that is the shoes are not proper and there could be so, many other factors.

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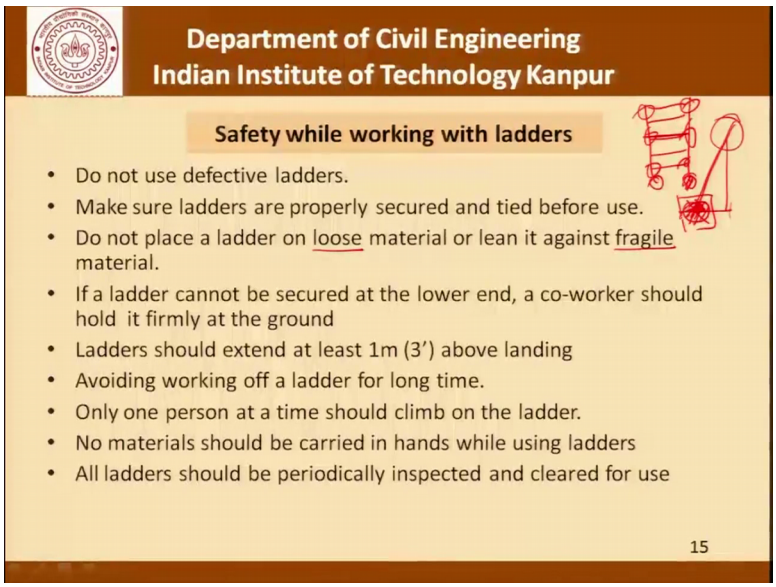

So, basically as far as safety while working with ladders is concerned some of the steps could be do not use defective ladders**.**

Make sure that the ladders are properly secured and tide before use do not place a ladder on loose material or lean it against fragile material what is being said is this that, if this is the ground and this the wall where ladders to be fixed when fixing the ladder which has the verticals like this and the rungs here. This point here should be properly secured this place; when the this place, where the ladder rest on the ground should not be loose, or fragile sometimes it is not possible to ensure that completely and in those conditions if a ladder cannot be secured at the lower end a coworker should hold it firmly at the ground it should be held in place and there should be a coworker which holds it in position.

Ladder should extent about 3 feet or a meter above the landing that is what is shown here if possible, a avoid working of the ladder for a long time which I have already said, only one person at time should climb on the ladder, no materials should be carried in hands when using ladders, all ladder should be periodically inspected and cleared for use.

Now what could be the kind of inspections that is required for a ladder it could include all these fittings of the rungs to the verticals. It could include the integrity of the rungs, it could include the fixtures at the bottom, it could include friction pads at the bottom of the ladder which help the ladder get a better grip on the ground. So, these are some of the things that have to be carefully and consciously watched and only then the ladder should be used at a side.

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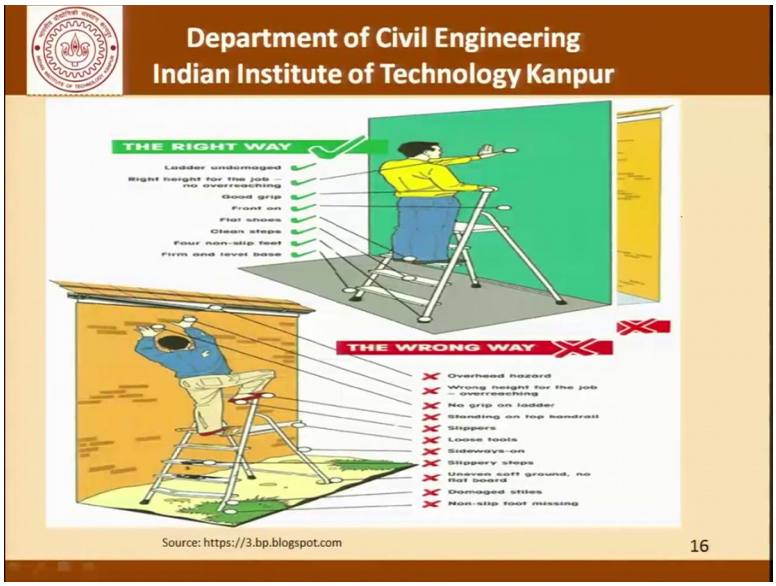

This picture here is of course, a Cartoonists way of looking at the right way of using the ladder and the wrong way of using the ladder. We can see that this person here is trying to work on a wall not facing the wall which leads to a very avoidable unnatural position for doing the work and is a safety hazard as for as the ladder is concerned.

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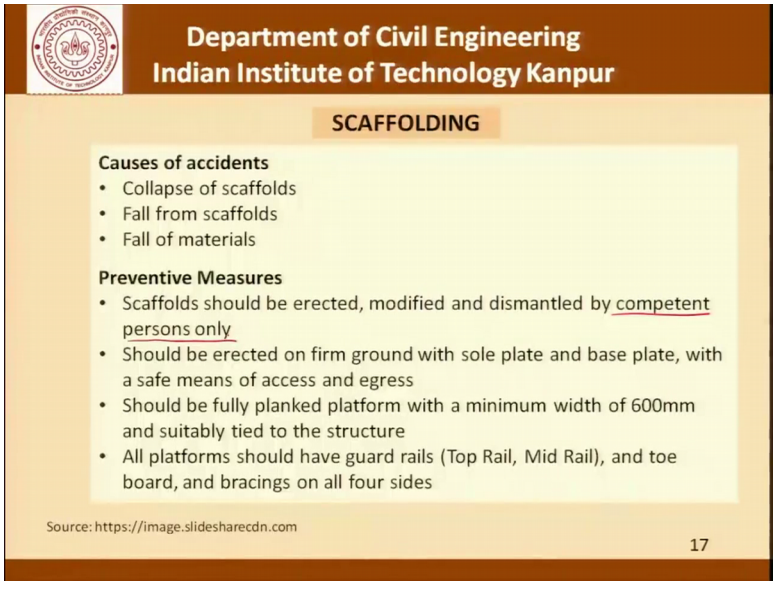

So, moving forward let us talk of Scaffoldings the Causes for accidents is for as scaffolding is concerned could be the Collapse of scaffolds, Falls from scaffolds, and Fall of materials of the scaffold. And some of the Preventive Measures would be there should

be erected modified in dismantled by competent persons only. There are people who are trained to assembles scaffolds, modify scaffolds and dismantle them; nobody else should unnecessarily try to do this work, please remember that one of the important things as for as safety is concerned is that there should be competent people who are doing their job. People who think that another person's job is very simple and they can do it should as far as possible avoid doing that. There will be some fine print in their job description which you are not aware of and that could lead to accidents.

The Firm work the scaffolding should be erected on firm ground with sole plate and base plate, with the safe means of access and egress, should be fully planked platform with the minimum width of 600 mm and suitably tied to the structure, all platform should have guardrails top rail and mid rail, and toe boards, and bracings on all four sides.

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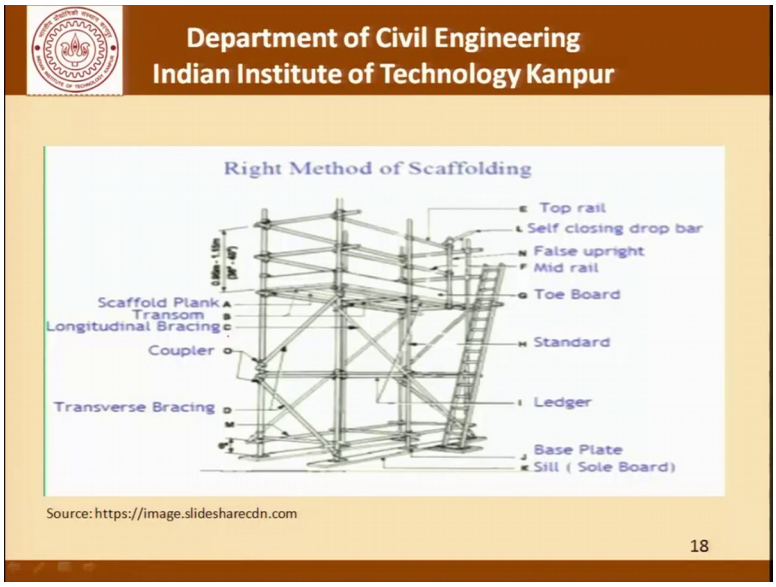

And this is a typical scaffolding which gives you the different details us to what are the components and how they have to be held in place. So, proper training program will enable workers to become proficient as far as handling scaffoldings are concerned. Now as far as construction sites are concerned the safety group can insist that a program for training workers by a competent person as far as assembling this scaffolding is concerned is held, but the program of course, has to be held by somebody who is in charge of the operations we have to identify the right kind of people to hold the program and make sure that the people handling scaffolding at their sites are properly trained.

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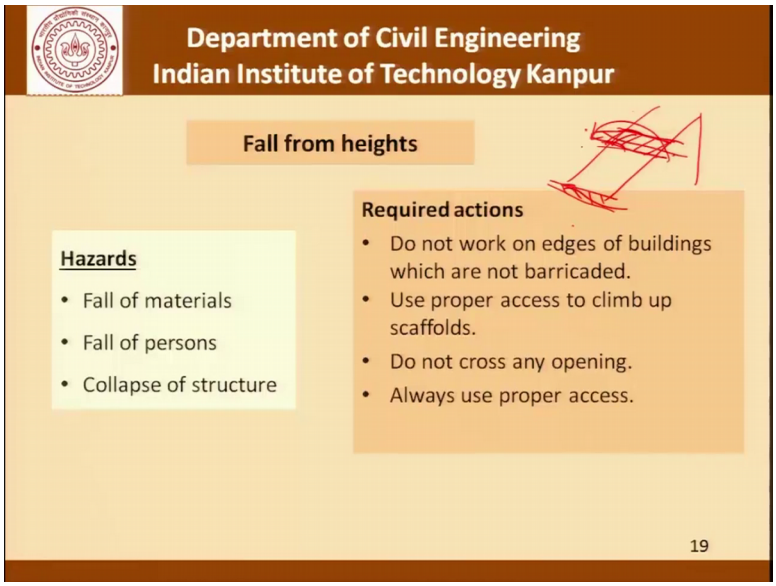

You recall that Fall from heights is the highest killer as far as accidents in construction sites is concerned. As far as fall from heights is concerned include Fall of materials, Fall of persons, and Collapse of the structure itself; and the required actions include do not work on edges of buildings which are not barricaded, Use proper access to climb up the scaffold, Do not try to cross or jump in opening, very often there is an opening and we should not try to just jump from one side to the other. In fact, if this opening is large the management has to ensure that appropriate platforms are created at certain distances if required. So, that workers working from one side can go together side safely and these platform; obviously, have to have handrails and barricades and so on.

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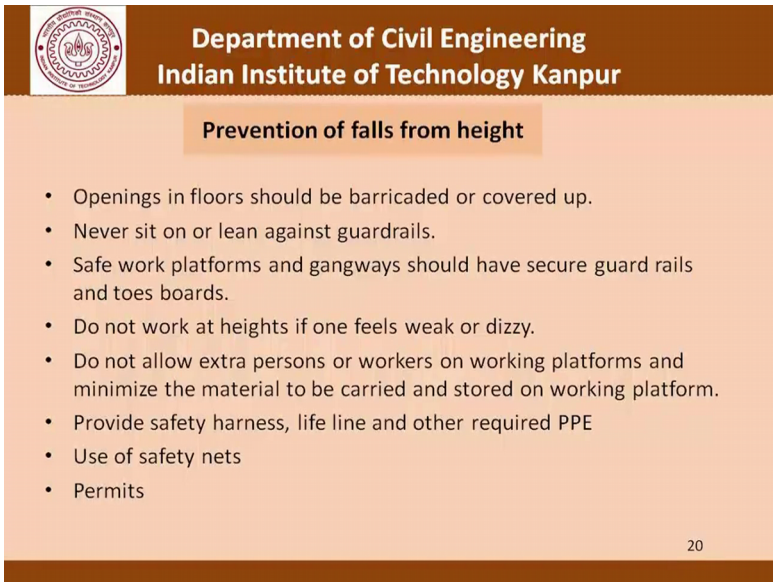

Always use proper access stairways should have handrails and as far as prevention of falls from heights is concerned it is a long list openings in floors should be barricaded or covered up very of 10 in multistory buildings, there are openings in the floors which are left for various reasons and it is important that they are all the time barricaded or covered up. So, that a worker does not fall through the opening, Never sit on or lean against guardrails, Safe work platforms and gangways should have secure guardrails and toe boards, Do not work at heights if one feels weak or dizzy. The important thing here is that only the worker knows that he or she is not in the best health to carry out a certain work.

It is important that there is enough confidence and the atmosphere generated in the site is such that a worker who is not feeling well is not allowed to work at site it is a hazard, do not allow extra persons or workers on working platforms and minimize the material being carried to and stored on working platforms, provide safety harness, lifeline and other required PPE as we will see in subsequent slides. Use safety nets and Permits working from height has another aspect that if there is work going on at height at a particular location a fall from an object whether it is a small nut or a bolt could cause an injury to somebody who is passing by below the person below may not even be aware of the work being carried out at a height of 20 30 40 meters.

And therefore, with the permit system it should be ensured that the area with the work is going on is properly barricaded at the ground level. So, that there are no passes by and people know that there is work going on in appropriate precautions have to be taken.

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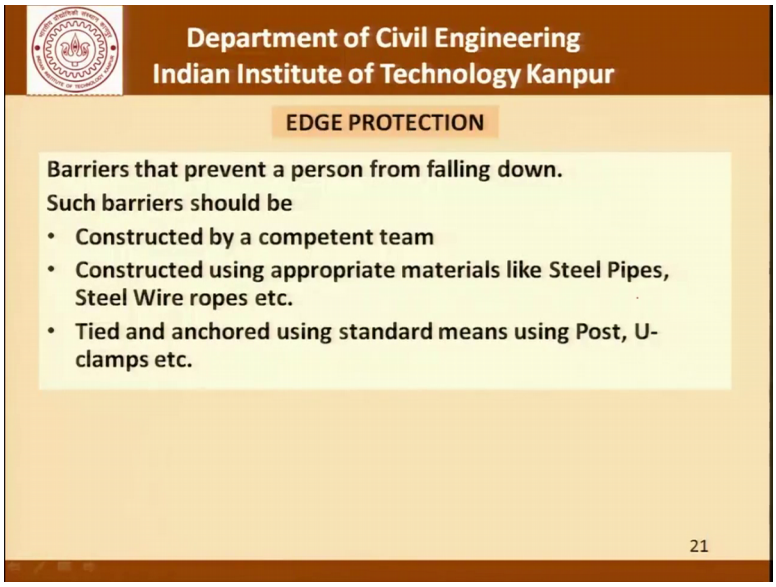

So, moving forward let us talk a little bit about edge protection Barriers that prevent a person from falling down is what edge protection is and these barriers should be Constructed by a competent team, and Constructed using appropriate materials like steel pipes, steel wire ropes and so on. And Tied and anchored using standard means such as posts, U-clamps etcetera.

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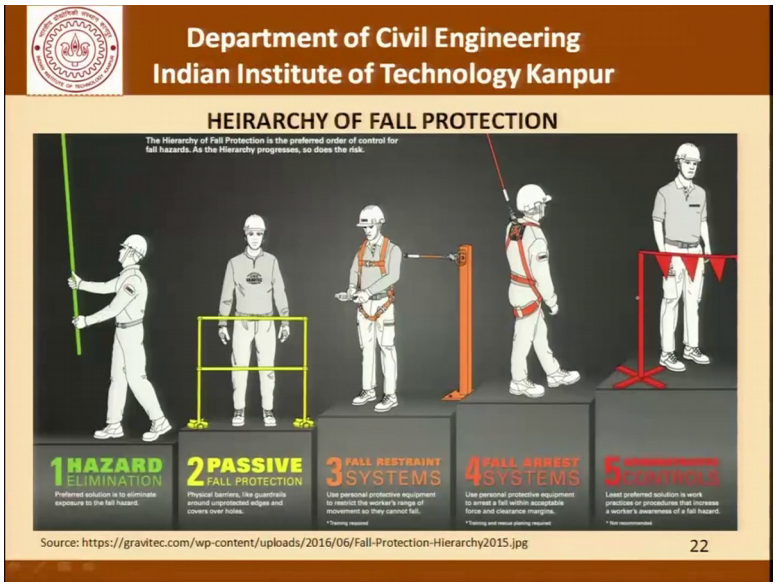

Now these slides in the next couple of them have been taken from the internet to just show, how the importance of fall protection has been highlighted in different ways. To this particular slide for example, shows the hierarchy of fall protection in a preferred order of control for fall hazards as the hierarchy progresses so, does the risk. The best thing to do is to eliminate the hazard altogether and the worst thing we can do is to just put an advisory that some work is in progress. In the middle we have Passive control methods such as putting the physical barriers, and we have active methods like the fall restraint system as the one that is being shown here, and we have another fall arrester system which is being shown here.

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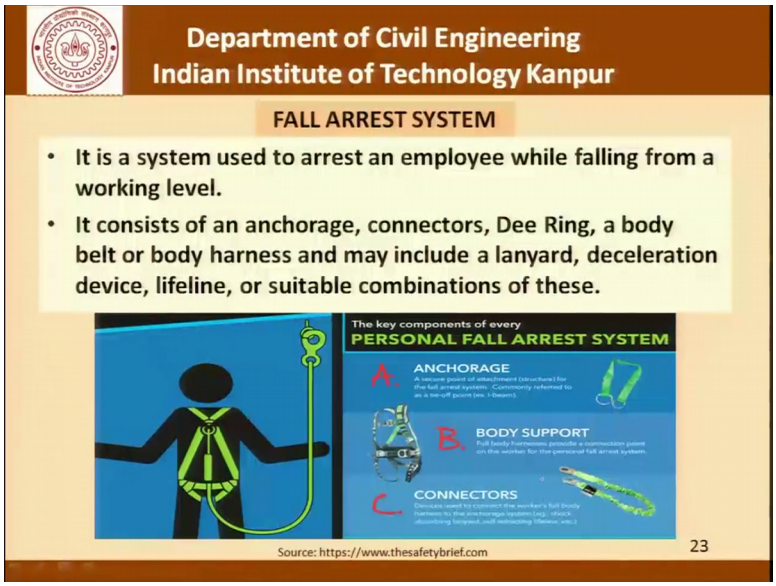

So, moving forward this is one of the examples of the fall arrest system, which is used to arrest in employee while falling from a working level it consists of an anchorage, connectors, Dee ring, a body belt or body harness, and may include a lanyard, deceleration device, lifeline, or a suitable combination of these.

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As far as working in heights is concerned of course, it is a very dangerous activity at a construction site and could lead to serious injuries and deaths and that is why it is one of the most prominent reasons for accidents in construction sites and it should be essentially

avoided by suitable access equipment and safety provisions some of which we have discussed in the discussion today. Now coming to electrical safety, which is the next topic as far as we are concerned for the day.

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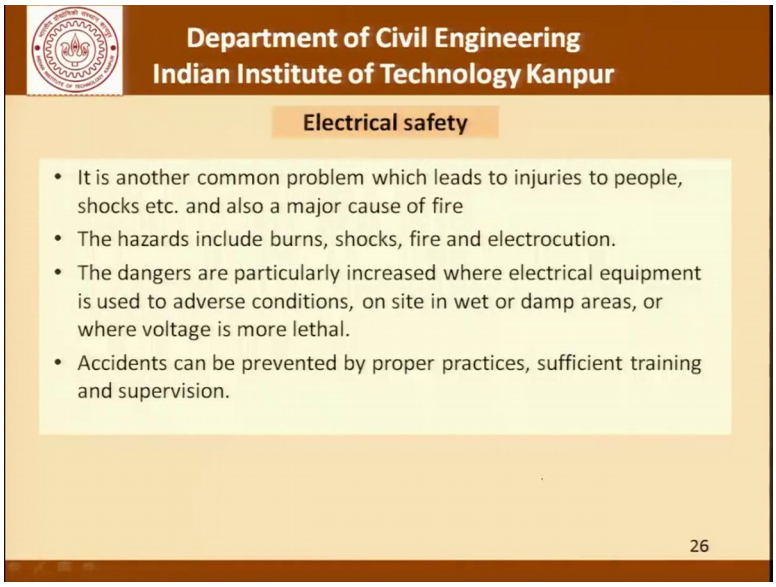

It is another common problem which leads to injuries to people, shocks and it also a cause for fire, the hazard includes burns, shocks, fire and electrocution, the dangers are particularly increased where electrical equipment is used in adverse conditions. For example, if the site is wet or in damp areas where the voltage requirement is lethal, Accidents can be prevented by proper practices, sufficient training and supervision.

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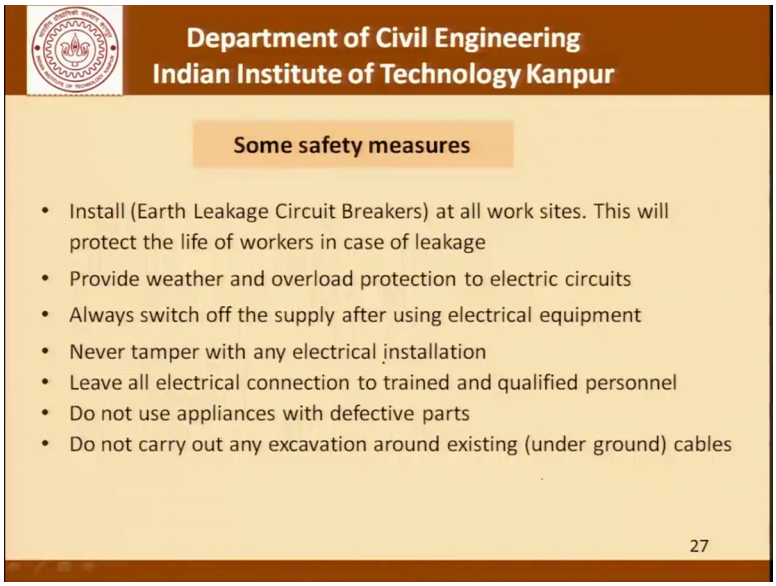

So, some of the safety measures that we can take is installation of earth leakage circuit breakers at all work sites and this will protect the workers in the event of a leakage. Provide weather and overload protection to electric circuits, always switch off the supply after using electrical equipment, never tamper with any electrical installation, leave all electrical connection to trained and qualified personnel.

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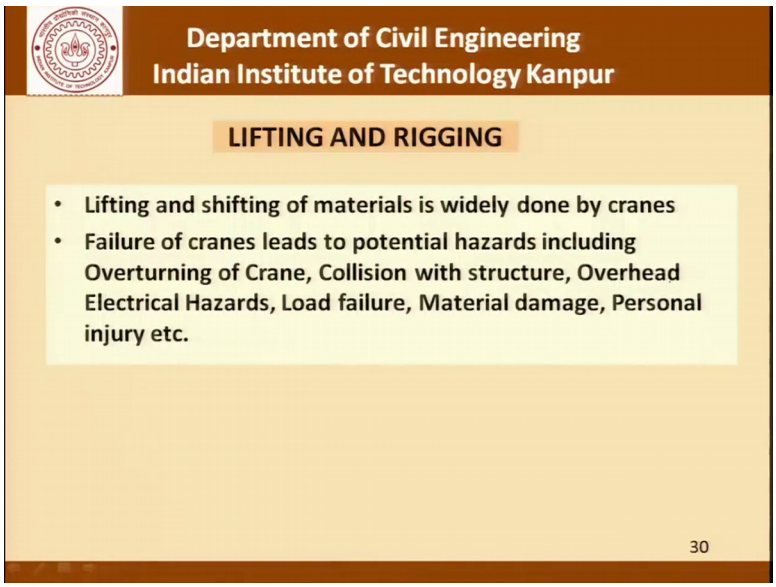

So, time and again it is to be emphasized that people who are trained to do a job should be the only people doing that job it may appear to be simple, but it may not be that

simple. Do not use appliances with defective parts do not carry out excavation around existing underground cables and continuing with the set of measures, all electrical equipment should be periodically inspected and certified for use this will bring up issues relating to defective equipment for the attention of the supervisors. All equipment must be provided with a 3-pin plug, 3-pin socket outlet, insulated cable and should have their specifications name plate attached in a clear location. Of course, this 3-pin plug or a 3-pin socket would largely depend on the kind of voltage supply and the location of the construction site, but what must be ensured is that a proper plug and socket is always used.

Keep fire extinguishers, sand buckets at the electrical booth and electrical equipment just in case there is an event, use spark proof and flame proof field distribution boards, and use the required PPE. If we are able to ensure compliance with these kind of measures we would be able to ensure affair reduction as far as accidents related to electrical work at construction sites.

Coming to the last topic for the discussion today which is Lifting and Rigging please remember that lifting and shifting of materials is widely done by cranes, Failure of cranes leads to potential hazards including Overturning of the Cranes, Collision of either the crane or the load that it is carrying with a structure, Overhead Electrical Hazards, where the boom of the crane hits a life cable, Load failure, Material damage, Personal injury and so on.

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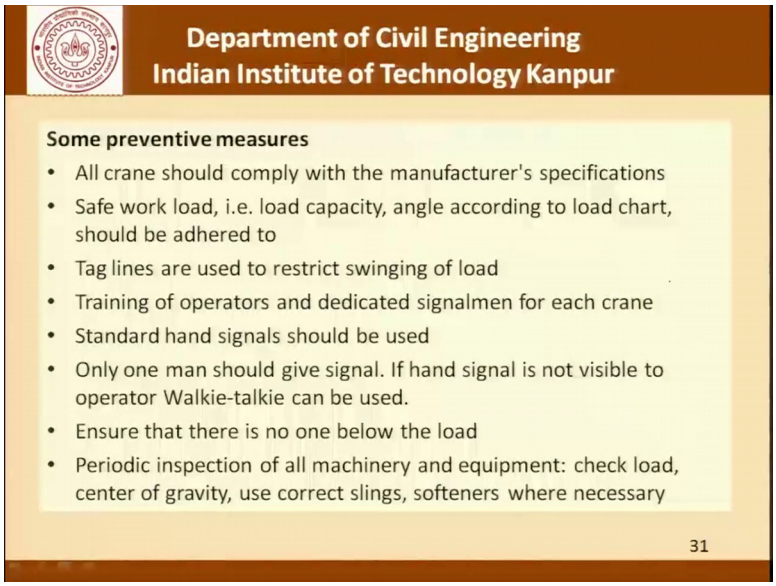

As far as some preventive measures as far as crane failure is concerned; all cranes should comply with the manufacturers, safe work load capacity angle according to the load chart should be adhered to.

The crane capacity; obviously, is related to the boom length angle at which the job is being lifted and so on. There is a chart which the manufacturer gives and there should be no compromise in using that. Tag lines are used to restrict the swinging of the loads whenever required a proper tag line should be used to ensure that the swing of the load is restricted. Training of operators and dedicated signalmen for each crane is an absolute must Standard hand signals should be used only one man should give the signal and if a signal is not visible to the operator; obviously, in this day and edge we could use walkie talkies, but what we must ensure is that there is a coordination between the person giving the signal and the guy whose operating the crane.

Of10 times they are not able to see each other and they are relying on signals being sent or communication between the 2 that has to be proper ensure that there is no one below the load and that brings us to the whole story of permits once again periodic inspection of all machinery and equipment check load center of gravity correct slings softeners where required and so, on. The moral of the story as far as discussion today is concerned is training of workmen competent people doing their job and periodic inspection of all kinds of equipment being used whether it is cranes slings or it is electrical equipment

drills hammers whether it is excavation equipment the excavation sites the shoring and so on.

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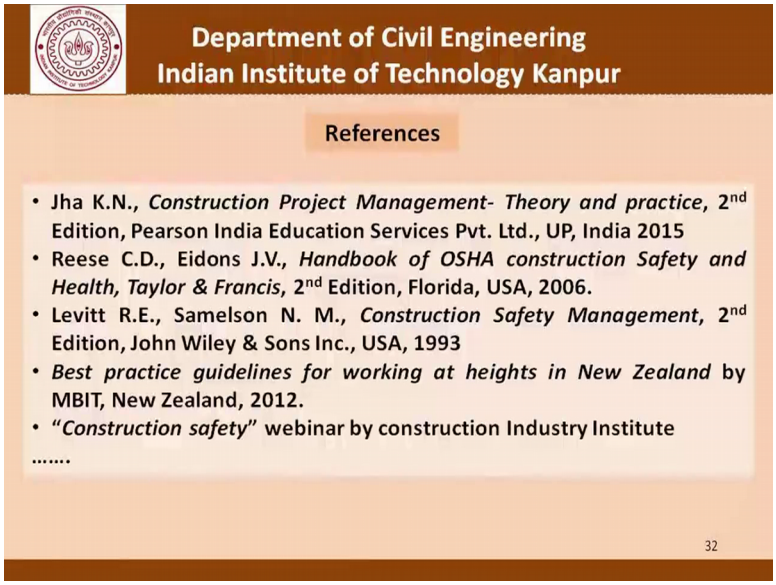

If you are able to ensure some of this we will be having a safer construction site, this slide here gives the some of the references of the websites and literature with which would help you get a better understanding and gives you case studies of construction accidents and I look forward to seeing you again in a subsequent class where will be talking about possible construction accidents under certain special conditions.

Thank you.