Chemical Process Safety
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Lecture 46
Accident Research: Introduction

Welcome to the new module related to the Accident Research and investigation so by this way we are starting a new chapter for Accident Investigation. Now accident investigation is a very vital because it gives you proper information that what went wrong and how we can change the things so that it should not happen in future.

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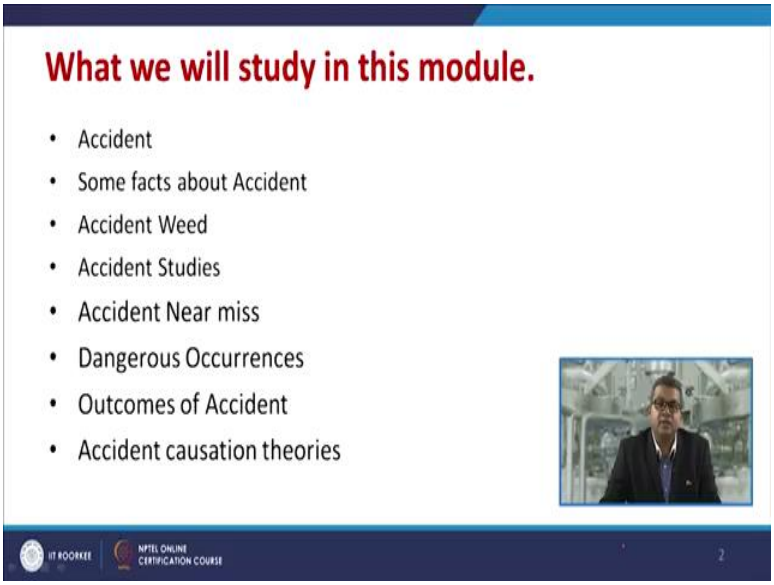

So in this particular module we are going to study about the accidents we will study about the accident weed then accidents studies. We will have a discussion about the accident near misses this word we have already discussed in previous modules. We will discuss about the various kind of dangerous occurrences and what is then outcome of the accident then we will discuss about the accident causation theories. What are the different applicable for this accident causation. So let us have a look about that what is an accident?

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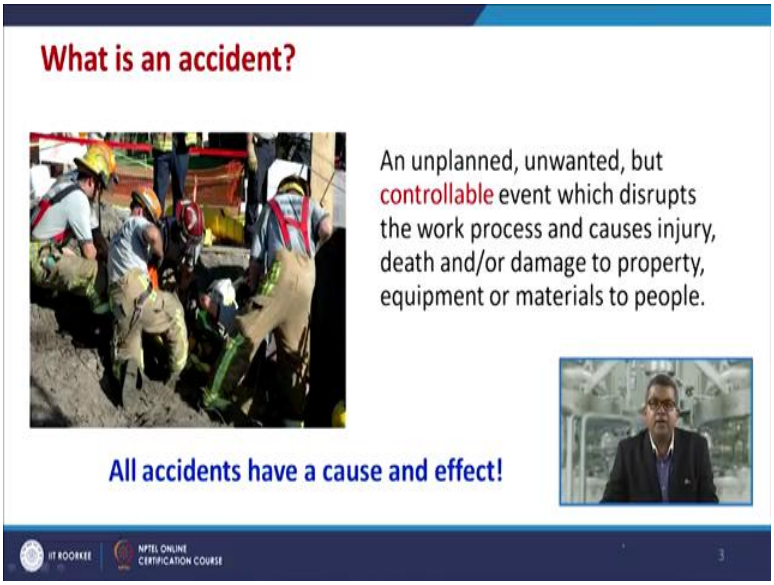

Now usually we had discussed previously something but the synchronized definition is that this is an unplanned, unwanted but controllable event which disturbs the work process and cause injury death and or damaged to the property equipment or materials to people. So in initial if you see that this may attribute to the entire economic loss of a particular plant or a country or anything else what you can see. So they all accidents they have a cause and effect this is the rule of thumb and this points needs to be remember throughout this particular chapter.

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Now an incident may disrupt the work process but does not result in injury or a damage it should be looked as a wakeup call sometimes it is referred as nearness etc. So it can be thought of as the first of a series of event which could lead to a situation in which harm or damage may occur. Now just for a sake of an example a 25 kilogram of carton falls offs the top shelf of a 12 feet high rack and lands near the worker.

Now this event is unplanned, unwanted and has the potential for injury. So suppose if it falls to the head of this particular worker then the problem would have been more severe. So that means presently in the present context it is not having any impact towards the injury or damage but it should be looked as a wakeup call.

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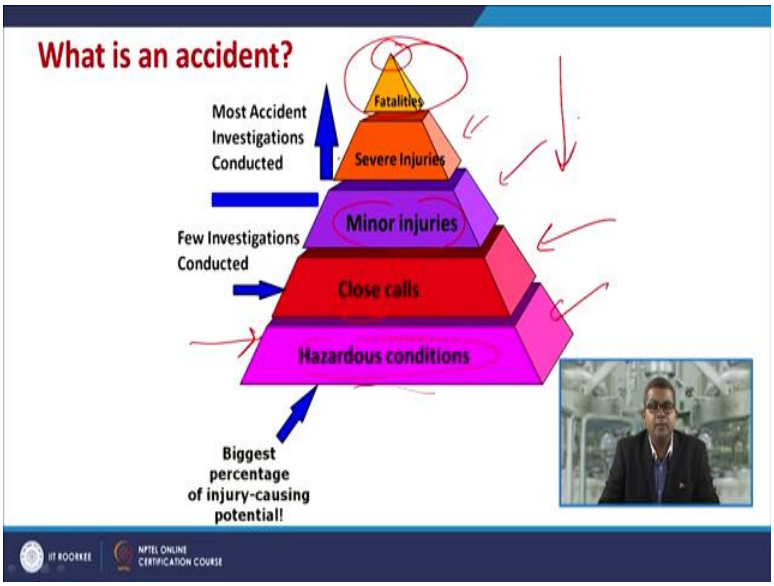

So while considering the accident it is just like a pyramid structure you may have n number of hazardous conditions that is the biggest percentage of injury causing potential like this we have discussed about the fall of this carton then you may have a various close calls so in this you may need to perform several investigations you need to conduct so that you can minimize these hazardous conditions. You may have a lesser number of minor injuries and sometimes it may happen that the cross section of this particular box may fall at the back part of this worker.

So the minor injury may call sometimes it may have a severe injuries so when you are carrying out this the most accident investigation usually they are conducted in from minor injury to the

severe injury and this may lead to couple of fatalities. So you can say this is the pyramid structure when you are having several hazardous conditions it may be n in number then a bit lower number in those are the close calls then the minor injuries and the fatality. So if you start the things right from the hazardous condition then you can minimize or you can reduce the size of this particular pyramid. This is the basic concept of this accident analysis.

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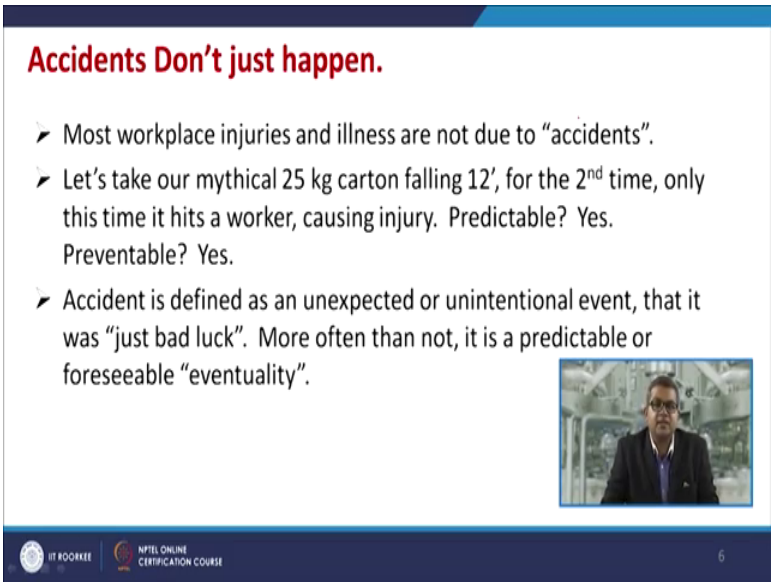

Now usually accidents do not just happen so most workplace injuries and illness they are not due to accident so let us take the mythical 25 kilogram of carton though falling from 12 feet of for the second time. So only this time it hits the worker this causing injury, predictable? Yes, ofcourse, preventable? Ofcourse, because you knew the things a priory so accident is defined as an expected, unintentional event that is that it was just bad luck so more often than not it is a predictable or foreseeable eventually.

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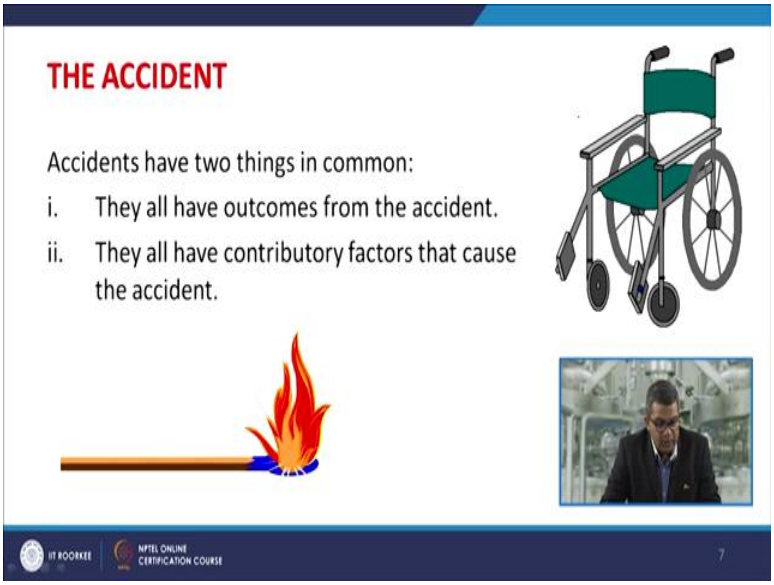

Now the accidents they have two things in common, one they all have outcome form the accident they all have contributory factor that cause the accident. So these two things are very important while considering the accident investigation.

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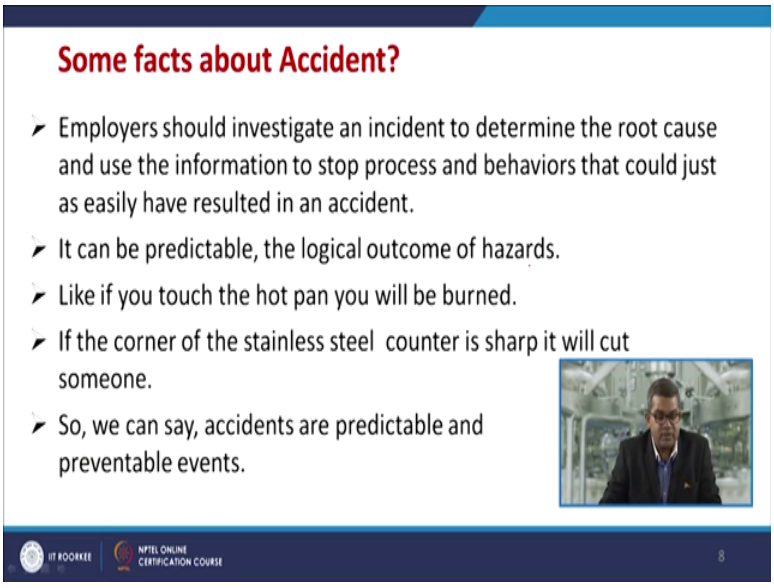

There are some other facts related to the accidents that employer should investigate an accident to determine the root cause because if you are having several hazardous conditions then obviously you have taken care of those hazardous condition. So anything like if you take the

previous example whenever any person who put it this particular carton to the top of the almirah then he never thought about that it will fall down.

So it maybe the hazardous conditions but it is the person is in the thought that he has taken all kinds of safety precautions but accidentally it fell down. So employer should investigate an accident there to determine the root case and use the information to stop process and behaviors that could just as easily have resulted in an accident. So it can be predictable the logical outcome of the hazards now like if you touch the hot pan you will be burned.

Now if the corner of this stainless steel counter is sharp it will cut someone. So you must analyze and you must have a proper information so that the corrective measures can be taken. So we can say those accidents are predictable and preventable events so when you are performing any kind of correctable measures then it is the preventable events. Now preventable and avoidable hazards do not have to exists.

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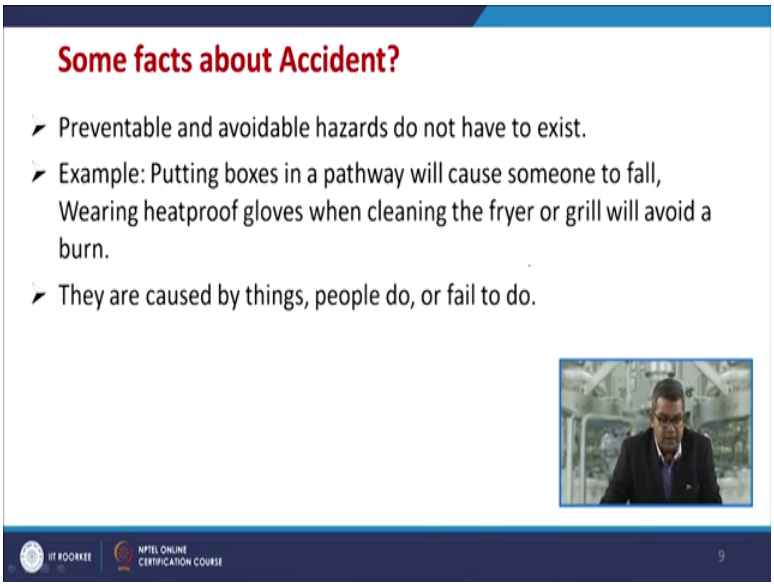

For example putting the boxes in a path way because someone to fall wearing heatproof gloves when cleaning the fryer or a pan or grill will avoid a burn. So they are cause by the things people do or fail to do.

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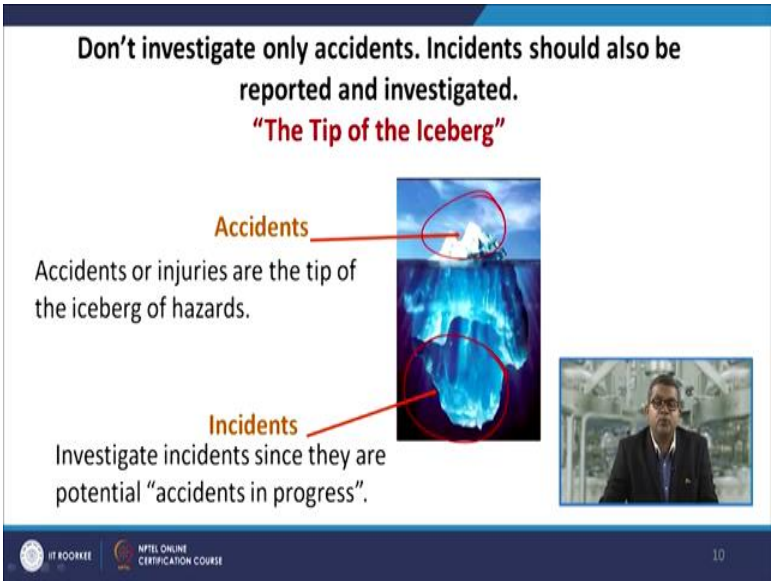

Now there are several other things which you need to know while carrying out any accident investigation do not investigate only accidents incident should also be reported and investigated. Like the tip of iceberg this is the accident the accident or injury at the top tip of the ice berg of hazard. Now the incident is that investigate incident is they are potential accidents in progress. So something maybe hidden and something may appear at the top. So you need to go into deep or detail.

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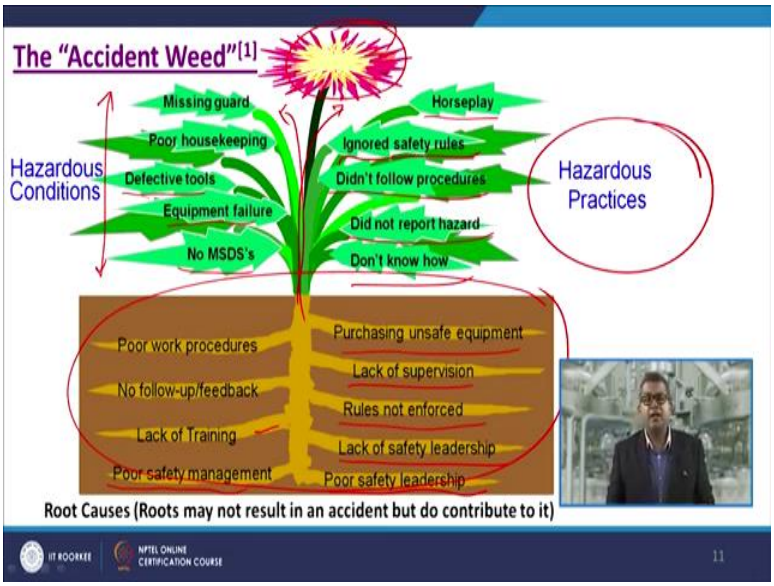

Now it is just like the accident weed. Now there are several root causes like this and they may attribute to the fruits or a leaves that is an outcome. Like the root causes these roots may not result in an accident but do contribute it. Like this there may be a chance of a poor work procedure, somebody not having the proper follow up or not given the proper feedback, there may be a chance of lack of a training.

Sometimes the lack of training and the person is not acclimatize to handle the scenario because of the lack of training then it may come in the form of accident then there may be a chance of a poor safety management sometimes it maybe a attributed to the purchasing of unsafe equipments because sometimes due to the economic aspect you may not be in a position to spend much money towards the safety of the equipment then there may be a chance of lack of supervision this may lead to the proper unfair housekeeping. Every equipment every process conditions they are having the set of rules need to be followed during the course of action and somebody or all the things all the rules are violated then there may be a chance that there is lack of safety leadership then the poor safety leadership may be just because of hesitation or reluctancy.

So these are the several root causes those are attributed towards the hazardous conditions. So when we talk about all these root causes there are certain things which may come out like may be attributed there may be no material safety data sheets sometimes it may be lead to the equipment failure sometimes because you have purchase some unsafe equipments sometimes it may come out in terms of are defective tools it may lead to the poor housekeeping sometimes it may have a missing guard etc. So these you can clearly visualize similarly there may be certain horseplay ignored the safety rules because you are not having the rules enforcement or this may be attributed to the lack of safety leadership.

So because you are having a lackness in the safety leadership so may not be in a position to follow the safety protocols or procedure did not the report the hazard when it was noticed like the fall of box or cartoon from the 12 feet high almirah then somebody those you may observe they should report to the officers or they should report to the supervisor that do not please do not put this box at the top because it may be dangerous to somebody else and because of the lack of training somebody they do not know how to handle the things. So these are the various hazardous practice so one should know this type of accident weed.

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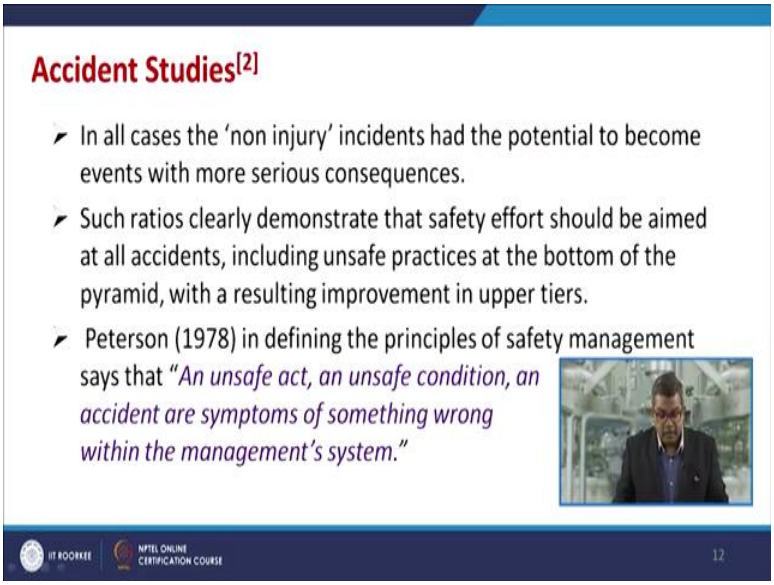

Now the accident studies is again a very integral part of this investigation so in all cases the non-injury incidents they had the potential to become events more consequences. Now such ratios clearly demonstrate that the safety effort should be aimed in all accidents including unsafe practices at the bottom of the pyramid when resulting improvement in upper tiers. So Peterson in 1978 in defining the principles of management and he said that an unsafe act, an unsafe condition and accident are symptoms of something wrong within the management system. So he gave this particular specific definition.

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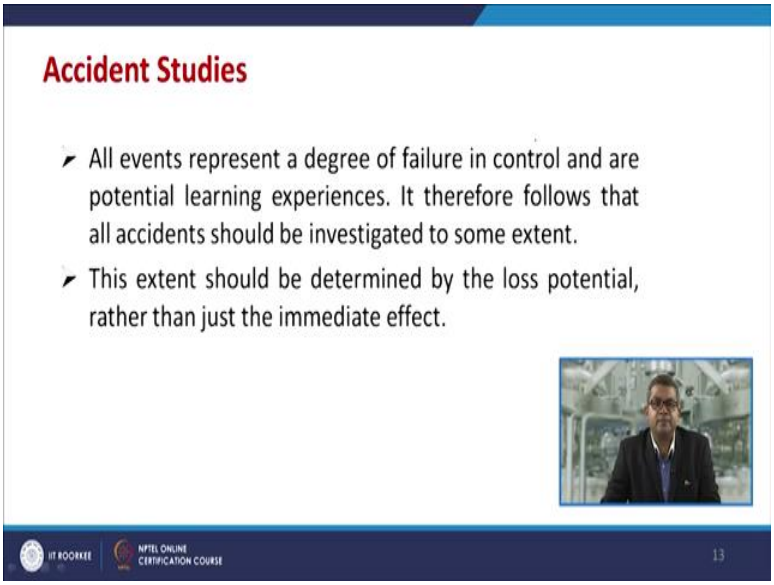

So all events they represent degree of failure in control and are potential learning experience so it is therefore follow that all accident should be investigated to some extent or sometime sit is referred at the same extent. So this extent should be determined by the loss potential how much is having the potential towards the loss so rather than just the immediate effect because this loss potential aspect will give you the futuristic aspect.

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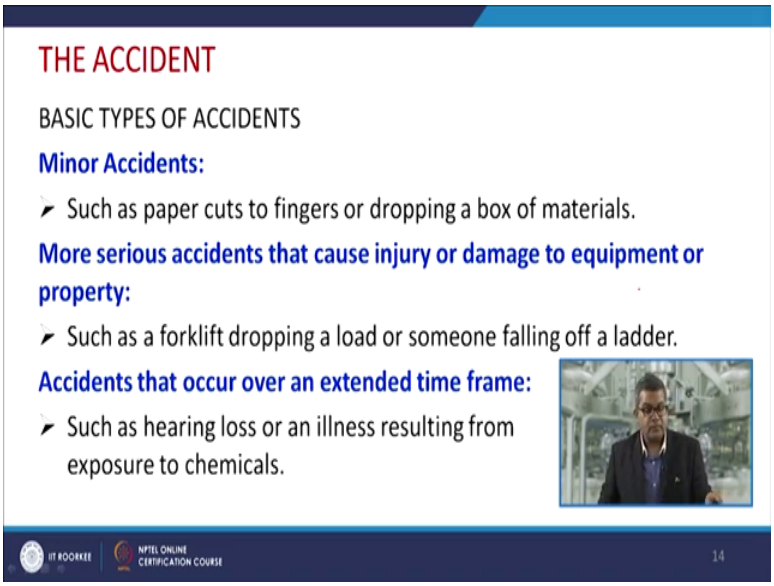

Now there are basic type of various accidents like minor accidents such as paper cuts to fingers or dropping a box of material which we had discussed. Now the more serious accidents that cause the injury or damage to equipment or properties such as forklift dropping a load or someone falling off a ladder. Now sometimes accident that occur over an extended time frame such as hearing loss or illness resulting from exposure to chemical.

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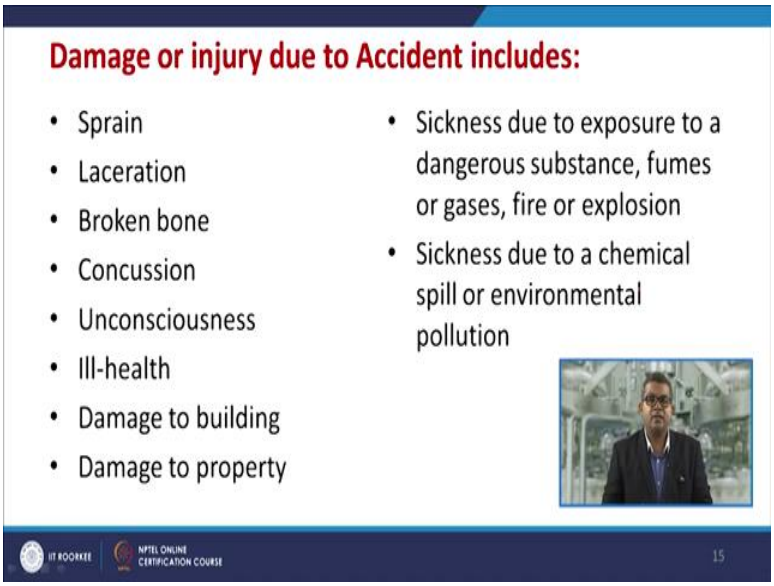

So there are damage or injury due to accident this includes sprain, laceration now laceration is deep cut or tear in skin or you can say any type of criticizing things etc then you may have a broken bone then you may have a concussion that is the mild traumatic brain injury which can cause head or brain to shake quickly back and fore.

You may have some unconsciousness you may have experience the ill health there may be a chance of damage to building there may be a chance of damage to property sometime you may experience the sickness due to the exposure to a dangerous substance fume or gases, fire explosion etc. Sometime one may feel sickness due to chemical spill or environmental pollution.

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Now let us have a look about the accident those who are near-miss, so sometimes it is also referred as a near hit. An accident that does not result any injury or a property damage but could have as a potential for serious consequences exists. Now remember the near miss is just a serious just as serious as an accident. Sometimes it may refer as just skipped.

Sometimes if you are crossing a road and some fast moving vehicle just come across then on the immediate action you may say that oh God that means just escaped from that particular accident. So remember these near misses is just as serious as an accident and it gives you a proper learning. It gives you a message that gentleman something is not correct.

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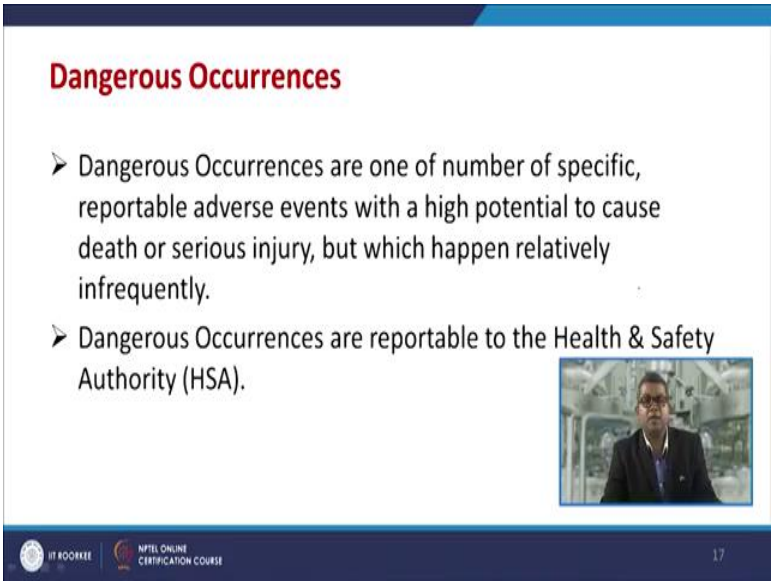

Now there are dangerous occurrences now this dangerous occurrences are one number of specific reportable adverse events with high potential to cause death or serious injury but which happen relatively infrequently. Now, this dangerous occurrences are reportable to the health and safety authorities HSA which are related to your local area or national area etc.

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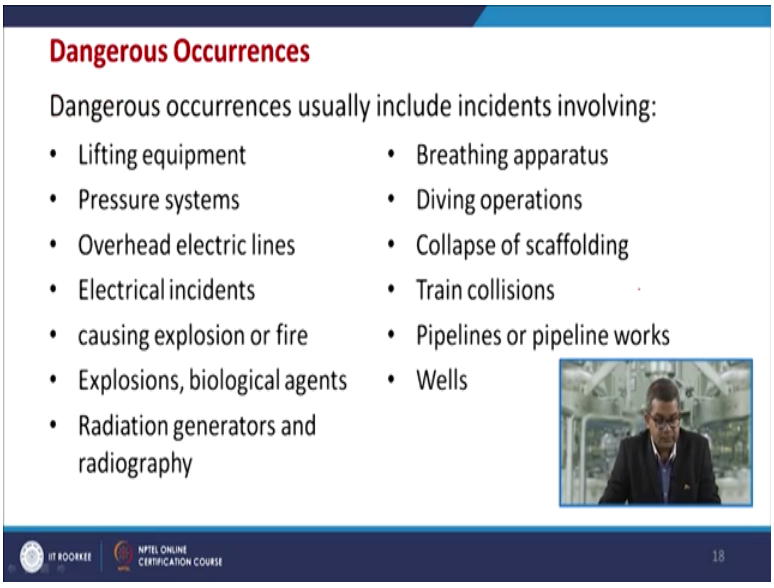

Now there are several dangerous occurrences like dangerous occurrences they usually include incidents involving lifting of an equipment, sometimes related to the pressure system, sometimes

attributed to the overhead electric lines, electrical incidents causing explosion or fire, explosion biological agents, radiation generators and radiography they may be attributed to the breathing apparatus, diving operation. Sometimes collapse of scaffolding, sometimes it may be attributed to the even train collision, pipeline or pipeline works, sometimes they are attributed to the wells or sometimes reservoirs etc.

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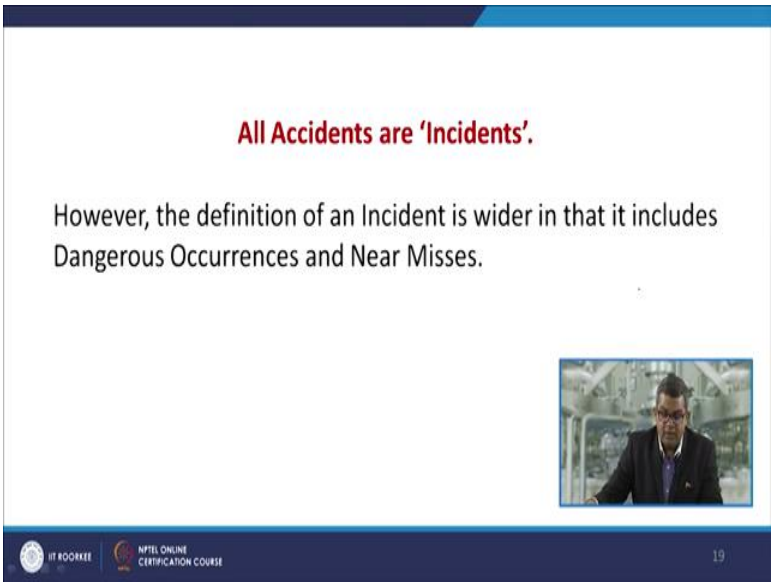

Now remember one thing that all accidents are incidents. So however the definition of an incident is wider in that it includes dangerous occurrence near misses.

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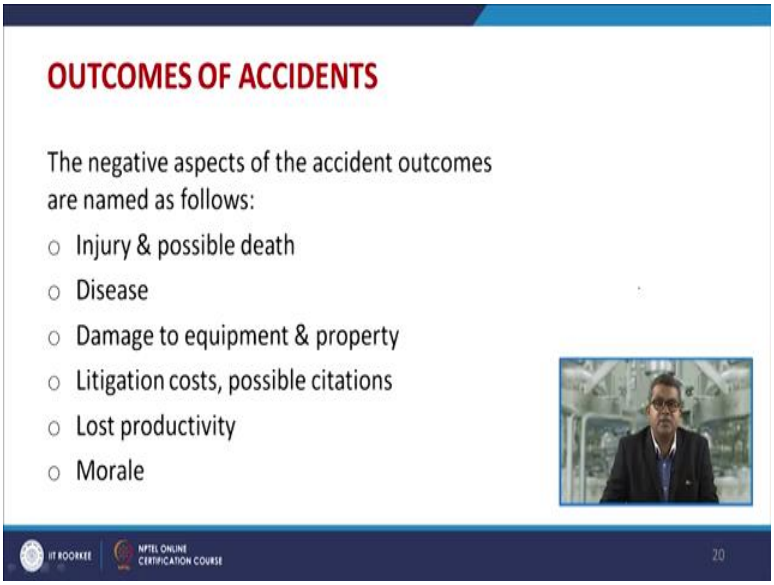

There are several outcomes of accidents. The negative aspect of an accident outcome they are named as like injury and a possible death or a fatality. So again it is a very serious because maybe a criminal offence or sometimes the company need to pay a heavy compensation. Sometimes it may be attributed to disease sometimes it is related to the damage to equipment and a property, sometimes company or industry may suffer the litigation cost and a possible citations that could adversely affect the image of that particular industry.

Above all they may have a chances of lost productivity because the production is on the negative side so sometimes it may happen that the company may out of the business it reduces or it diminishes the moral of the company management as well as the company workers.

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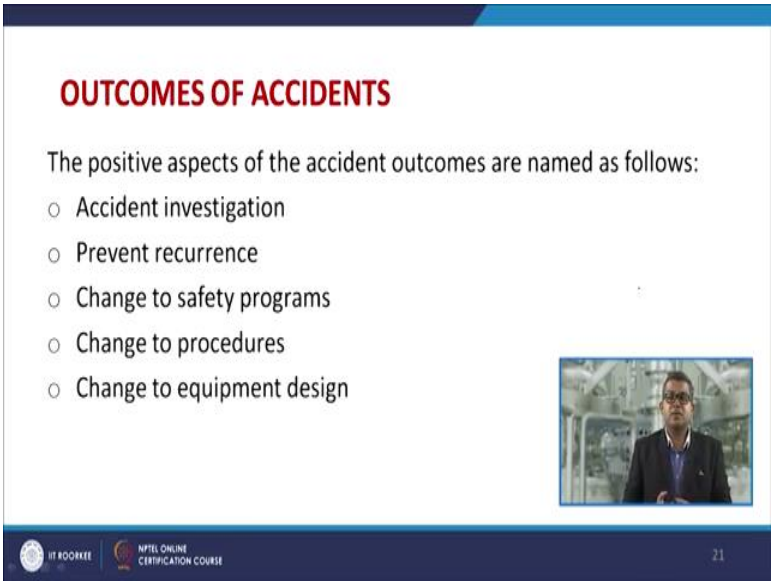

The positive aspect of the accident outcomes they are like proper accident investigation so you can prevent the reoccurrence of accident because if you properly investigate the things then you can find out the root causes and subsequences so that you can prevent the reoccurrence of that accident then this proper accident investigation or outcome may compel the company management to change the safety programs because if there is any lack in that safety program this may again may lead to the accident.

Then sometimes it may refer the company management to change the operating procedures sometimes you may use a lesser hazardous substance sometimes you may use the lesser flammable substances etc. and based on this two change to safety program and the change of procedure sometimes you may need to even change the equipment designs so that you can operate the things in a less hazardous manner. So ultimately you can prevent the reoccurrence of any accident so that is why the outcome of accident is extremely important.

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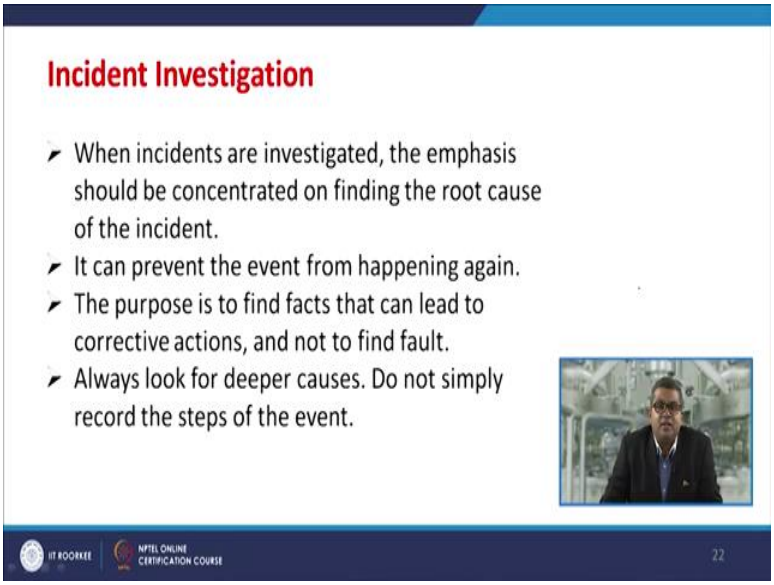

So let us have the discussion about the incident investigation so when incident are investigated the emphasis should be concentrated on finding the cause of the incident so it can prevent the event from happening again or reoccurrence. The purpose is to find the facts that can lead to the corrective actions and not to find any kind of fault. You need always look to for a deeper cause do not simply record the steps of the event so one must apply his or her own brain.

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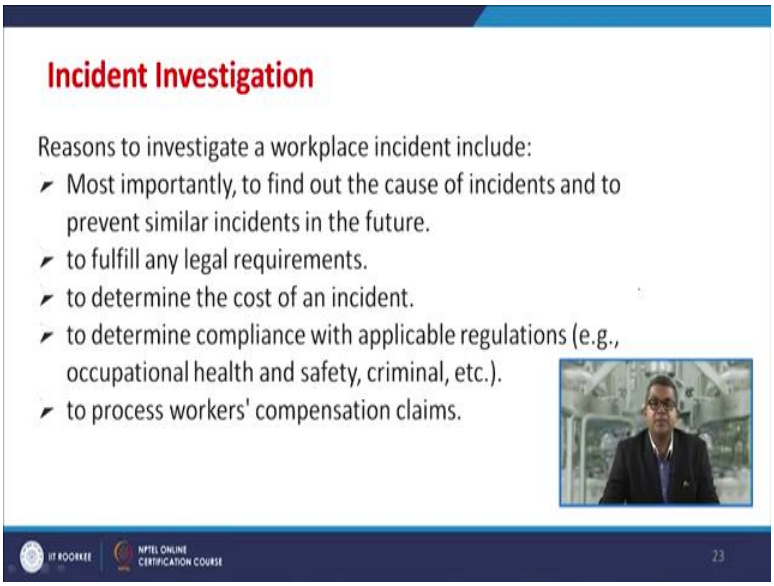

Now the reason to investigate a workplace incident this includes the most importantly to find out the cause of incident and to prevent the similar incident in future.

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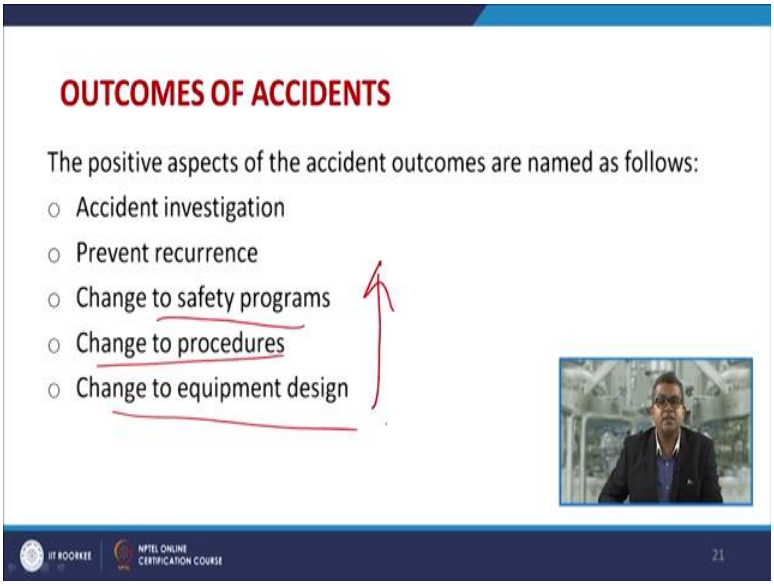

Because if you recall this particular slide the cause of accident will give you major impetus towards these three aspects like change to safety programs, change to procedure and change to equipment design. So you must have some ground to adopt this three things. The purpose is to find the fact that it can lead to corrective action and not to find the fault so always look for a deeper cause do not simply record the steps of cause. Now another reason to investigate the workplace incident include the most important to find out the cause of incident and to prevent similar incident in future.

Now because sometimes the legal requirement play a very vital role so and all industries they are compel to follow all kind of legal requirement may be the state level or may be national level or may be to the global level. So it is mandatory to fulfill any legal requirement that may lead to the accident investigation. Now to determine the cost of an incident that means partially you are performing the economic analysis.

To determine the compliances with applicable regulations that is occupational health and safety sometimes if in case of fatality or injury you may have to encounter the criminal proceeding etc. To process the workers compensation claim because whenever there is an injury or a illness or a

fatality then definitely there may be a chance that the process workers may seek the compensation maybe towards their medical bill maybe towards the one time settlem4ent etc so that is why these are the reasons to investigate the workplace.

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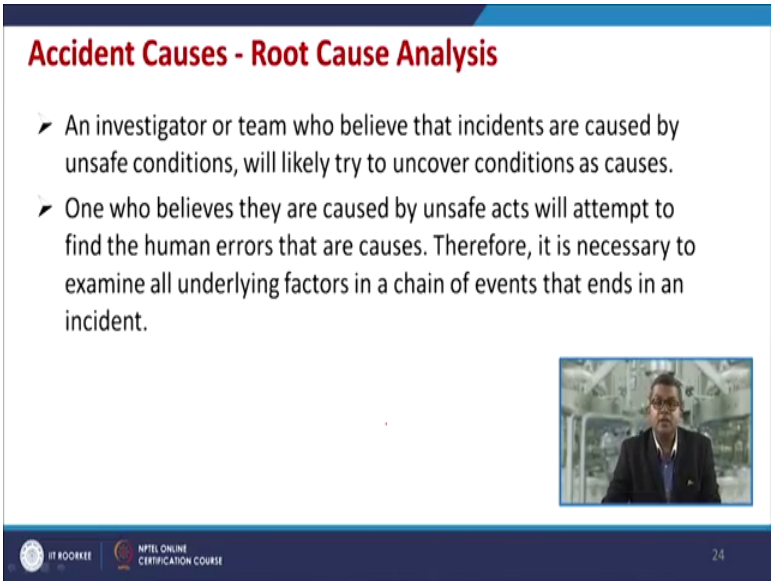

Now, let us have the accident causes and first of all this is the root cause analysis. So an investigator or a team who believe that accidents are caused by unsafe conditions they will likely to try to uncover the conditions as fast. So who believes they are caused by unsafe act will attempt to find the human error that are causes and therefore it is necessary to examine all underlying factors in a chain of event that tends but that ends in an incident.

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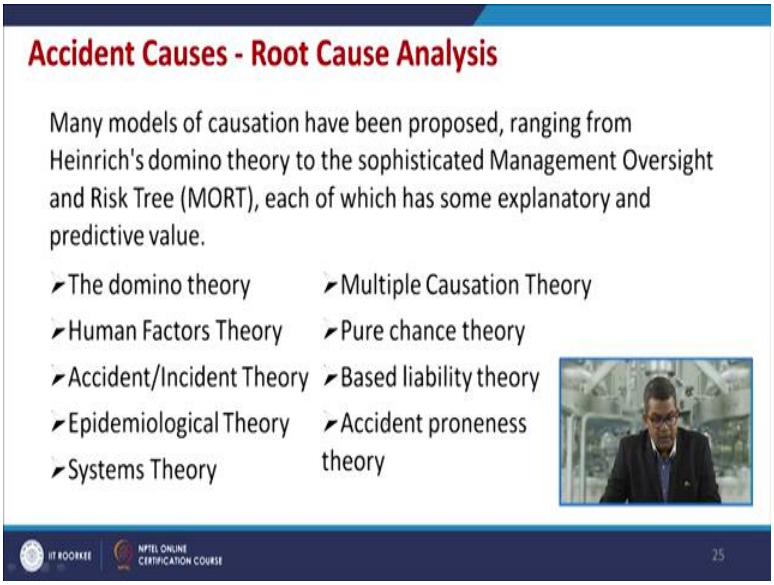

Now many models of causation have been proposed ranging from Heinrich domino theory to the sophisticated Management Oversight and Risk Tree that is referred as MORT. Each of which has some explanatory and predictive values like The domino theory, Human factor theory, Accident incident theory, Epidemiological theory, System theory, Multiple Causation theory, Pure chance theory, Based liability theory, Accident proneness theory so these are the several theories being predicted in due course of time for accident causes.

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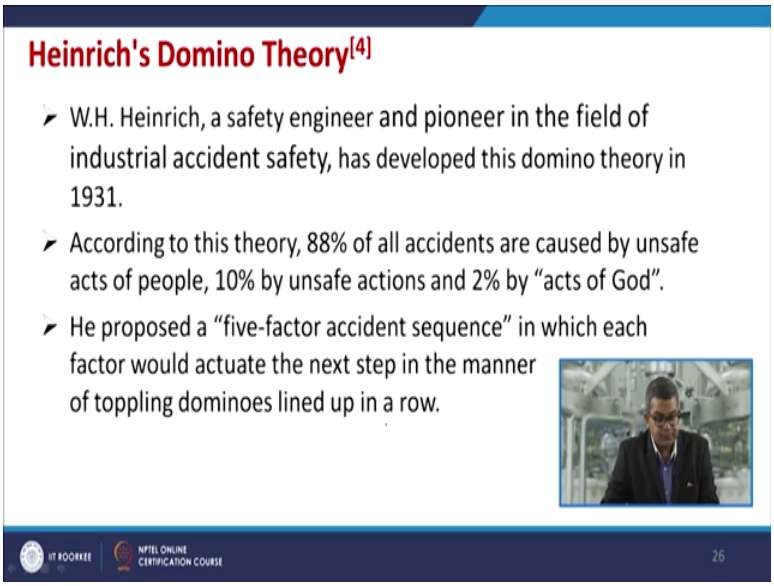

So let us have look about the Heinrich Dominos Theory, now W H Heinrich safety engineer and a pioneer in the field of industrial and accident safety he developed this domino theory in 1931. So according to this theory almost 88 percent of all accidents are caused by unsafe acts of people, 10 percent by unsafe actions and 2 percent by acts of God may be natural calamity etc. So he proposed a 5 factor accident sequence in which each factor would actuate the next step in the manner of top toppling dominoes lined up in a row.

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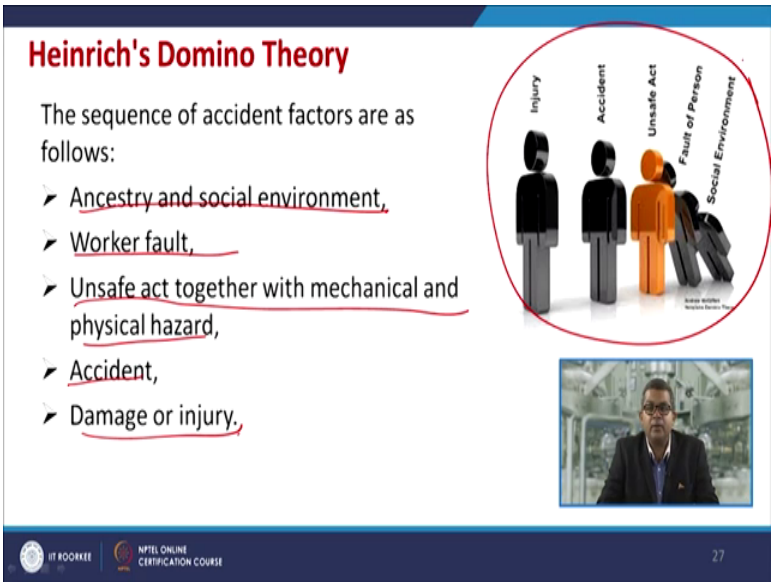

Now the sequence of accident factors are as follows like ancestry or social environment, worker fault, unsafe act together with the mechanical and a physical hazard, the accident and damaged to injury. So these are depicted in this particular figure.

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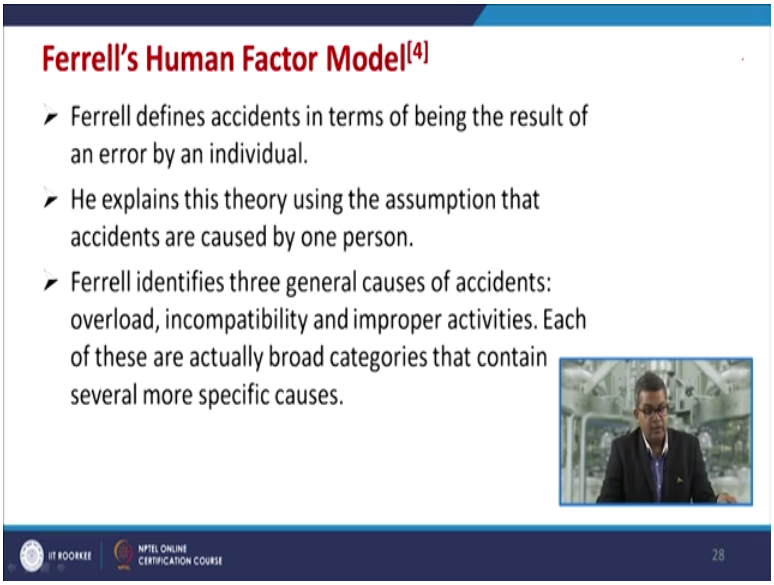

Another is the Ferrell's human factor model now Ferrell he defined the accident in terms of being the result of an error by an individual and he explained this theory using the assumption that accidents are caused by one person. Now Ferrell identifies this the three general causes of accidents, one is the over load second is the incompatibility and third is the improper activities. So each of these are actually broad categories that contains several more specific causes.

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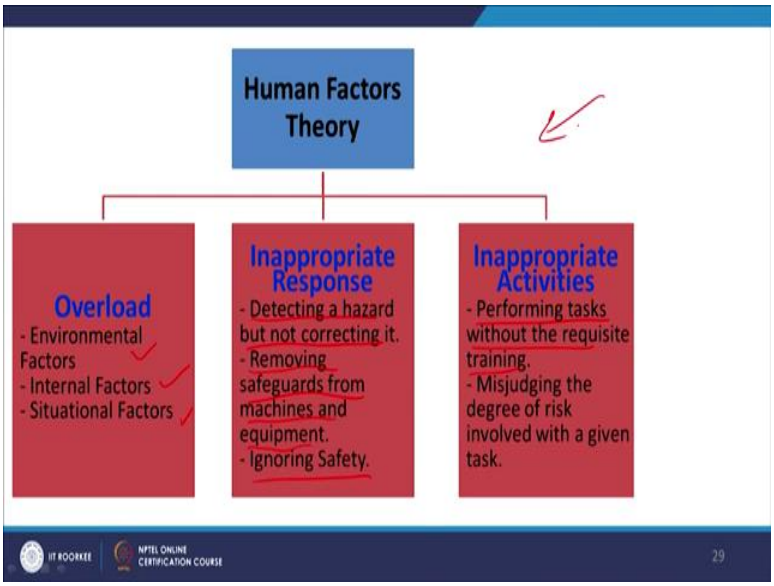

Now this is the human factor theory and all three aspects enlisted over here now overload may be the environmental factors they are attributed there may be certain internal factors and sometimes it may be a situational factor. The inappropriate responses they detecting the hazard but not correcting it then the removing safe guards from the machines and equipments sometimes it may happen when (they) there is a wear and tear sometimes even you are compelled to remove any kind of guard or offencing etc from the chain pulley system etc and sometimes it may happen because of the ignoring the safety aspects or the safety rules.

Then there are certain inappropriate activities like the performing task without the requisite training that is the lack of safety management then misjudging the degree of risk involved with the argument task. So this is this table gives you the human factor theory that we have enlisted some couple of examples of each aspect like over load, inappropriate reasons and inappropriate activities. So let us have a brief discussion about this model that is improper activities usually is the perhaps the simplest of the concept.

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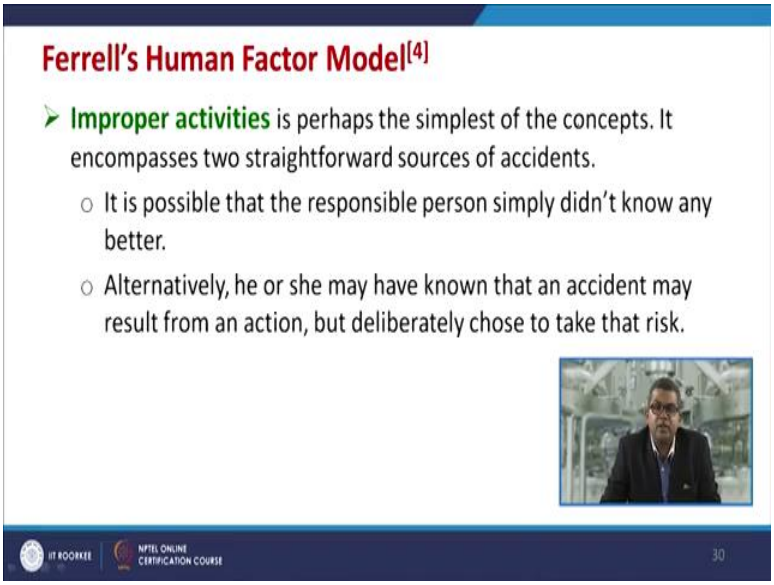

Now it encompasses two state forward source of accident one is it is possible that the risk responsible person simply did not know any better. Alternatively he or she may have known that an accident may result from an action but deliberately choose to take that particular risk. So if you are innovative or if you are enthusiasts then you may be in a position to take this risk deliberately.

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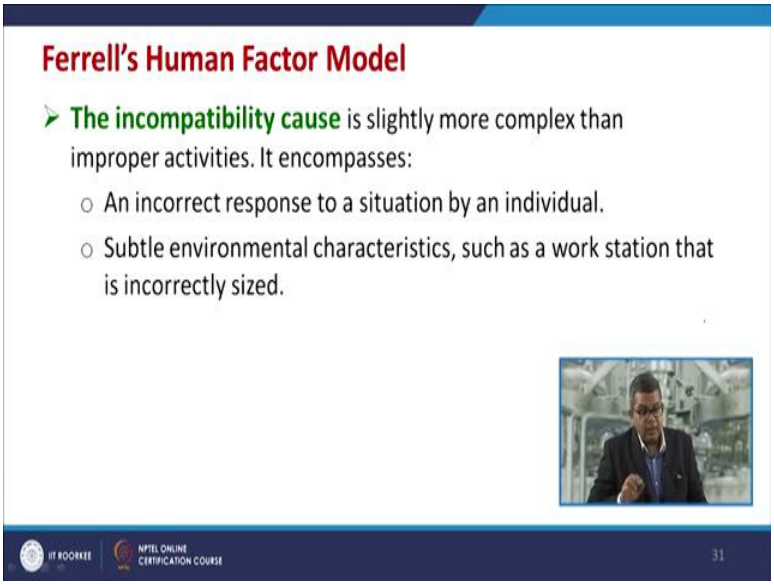

The incompatibility cause is slightly more complex than improper activities. Now it encompasses the incorrect response to a situation by an individual and subtle environment characteristic such as workstation that is incorrectly sized.

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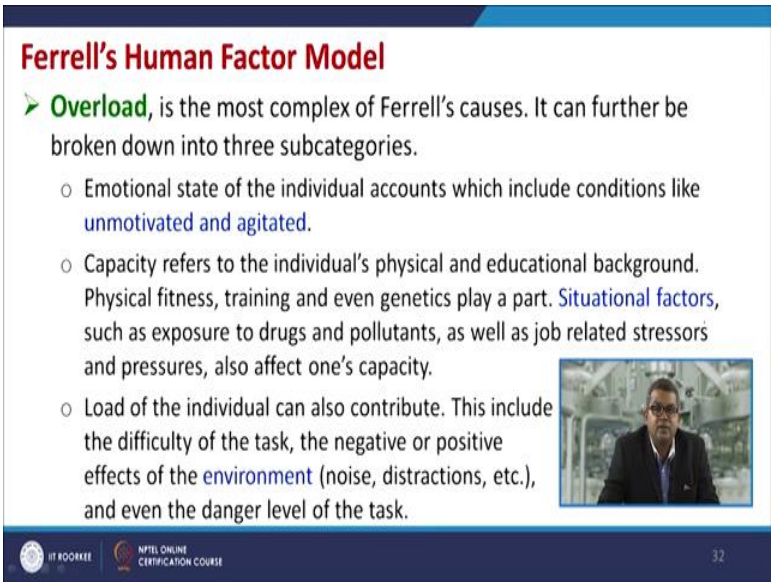

The third is the over load now this is the most complex of Ferrell causes it can further be broken down into three subcategories. The emotional state of the individual accounts which include conditions like unmotivated and agitated. Now agitation may be attributed to the various reasons

somebody may be suffered from the home problem and may be at the workplace problem etc. so it has so it is having a large spectrum.

Now second aspect is the capacity this capacity refers to the individual physical and educational background, physical fitness, training and even genetics plays a vital role. The situational factor such as exposure to drugs and pollutants as well as job related stress and pressure they also effects ones capacity.

The third one is the load of an individual this can also be major contributor now this includes the difficulty of the task the negative or a positive effects of the environment may be noise distraction etc. and even the danger level of the task so this is the main contributor towards the over load.

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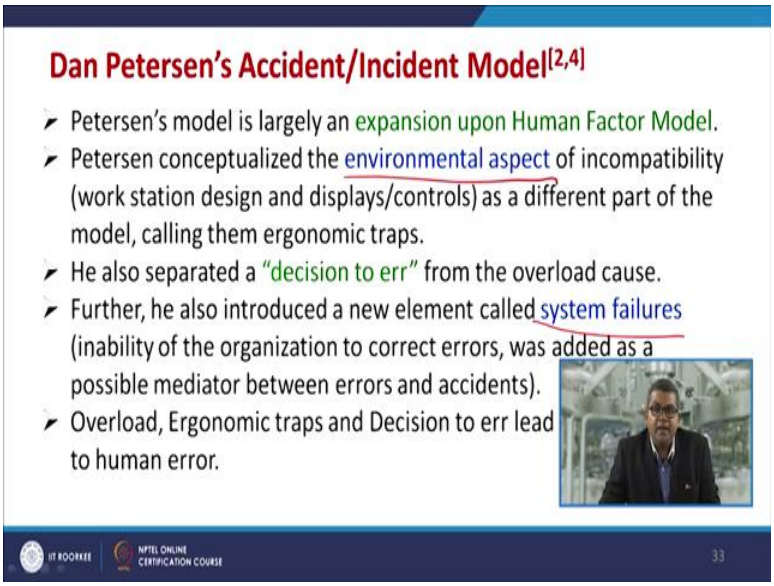

Another model is attributed to the Dan Petersons Accident or Incident model, so the Petersons model is largely an expansion upon human factor model. Now Petersons conceptualize the environmental aspect of incompatibility like work station design, display, control etc so as a different part of the model they are calling them the ergonomic traps and now it is various companies they are paying much attention towards the this environmental aspect. He also separated a decision to err from the overload cause, further he also introduced a new element that

is called the system failure. Now this system failure attributed the inability of the organization to correct errors and this was added as a possible mediator between errors and accidents.

So over load, ergonomic trap and decision to lead human error.so in this particular module we had discussed about the basic broad definition of accident the accident investigation protocol we have gone through the root cause analysis of accident we have discussed about the importance of accident investigation and we had a discussion of three models related to the accident in incident etc. In the subsequent module we will discuss these models in detail, thank you very much.