## Safety in Construction Prof. Uma Maheswari Department of Civil Engineering Indian Institute of Technology-Delhi

# Lecture-5 Safety Program Accident/Incident Investigation

So, welcome you all to this particular class. So, this class is primarily on accident investigation. We can also interchangeably as an incident investigation, so both are almost the same. If you want to have zero accidents in site, primarily you have to attack all the incidents. Incidents, when there is an impact, it is an accident otherwise with no impact is a near miss.

So, if you want to achieve a zero accident and a very safe construction site, primarily all incidents should be investigated. So, we can term this as incident investigation or accident investigation, both are colloquially same.

(Refer Slide Time: 00:59)



So, why should we do accident investigation, how should we do accident investigation all we will discuss in this particular class. So, what do you mean by hazards; just brushing up from the previous week's lecture. So, hazards are the dangerous situations or conditions that can lead to accidents. So, construction site generally it has so many hazards and these hazards are always challenging even for a skilled experienced worker also.

Because sometimes the situation may not be the same. So, the earlier technique that you use to eliminate or safeguard the hazard will not work in every situation. So, hazards always pose a serious challenge to workers. And many workplaces have high accident incidence rates and accordingly they also have a high severity rate because of these hazards. So, hazards should be discussed in the sense hazards primarily they are the root cause for any accident but that does not happen every time.

For any event to be called as an accident, there should be following characteristics. Number one there should be an outcome and if the whole incident itself is like planned even by knowingly you know that one equipment is not working, but still, you want to operate that equipment, it may create danger to yourself or to your co-workers. Then actually it is considered to be a crime and it is not treated as an accident at all.

So, that should be kept in mind in the workers and in the construction personnel. So, the personnel injury or property damage may result as an effect of an incident, so this accidents has to be investigated. An occurrence of accidents also differs from site to site, because the nature of work itself varies or even if the work is similar in nature environment may vary. For example, if you wanted to do tunneling, you may cross so many barriers and so many obstacles.

So, the physical way of executing the work progress itself will differ based on the challenges that comes in forth. Different types of hazards emerge in the project, because the project is generally unique and challenging. An unsafe people involved in executing the construction activities, that is also a common factor which we have seen in the last week's class also. So, most of the accidents are actually linked with unsafe activities of the workers available in the site. So, just to have an idea on what are the causes of accidents, and what are their effects.

(Refer Slide Time: 03:50)



So, causes, you can start from carelessness of the work nature, even though you know you have to take care of all precautions, and how to execute the work. Sometimes it goes off your mind and you are careless, and negligence to follow safety rules to follow all procedures. So, that is primarily one of the reason and it also ranks number one in many of the construction sites. Unsafe working conditions, for example dropping or throwing materials from high rise structures.

Just because you do not want to come down or pass on the material through different ways like chute or something. So, dropping, so that is primarily an unsafe working condition or practice. Failure to follow safety rules, primarily if there is an improper way of operating an equipment or improper way of executing a construction work, or it can be operating a defective tool or machine.

These are all failures to follow safety rules, even failure to wear PPE is also one of the violations in safety rules. Improper use of safety items, for example scaffolds or faulty ladders, the way scaffolds are used in construction sites, all these can be examples. Now if you see here workers are the primary party who are affected because of any accident or injury that we have seen, but who are the primary contributors? Again, some statistics and analysis were conducted, and during the survey, it was found workers were the main contributors in contributing to an accident. Now whether there is an incident or an accident or in the severity or impact of the accident, keep that aside, but what about the effects of all these accidents? Number one will be time lost on project execution, so you just have to have a break to come back to normal on the incident or the accident consequences.

Then productivity loss, if the severity of accident is too high, then you may have a complete stop or nil work in the entire construction site premises. So, thereby you may also have productivity loss. Then cost, medical expenses, treatment, recruiting an alternate worker with for the compensation, then training, etc., then cost on the accident investigation, time, effort, personnel. So, all these are unnecessary cost as a result of accidents, so accidents have to be controlled.

Reputation of firm, psychology of workers that every time the workers start feeling that they are always unsafe in a workplace that psychology can also make them demotivate, less productivity and so on.



(Refer Slide Time: 06:43)

Now what do you mean by accident investigation? And why should you do accident investigation? So, now we are into the topic now, so it is important to investigate all accidents, regardless of it is impact or effect that is what I said. Even an incident should be investigated

because sometimes you may have an impact, no impact as a near miss but you cannot keep quiet as a result of the same.

Because some unnecessary event has happened, some unwanted event has happened which you should be really looking at in analyzing and investigating. So, that is what I said colloquially, in this particular topic you can use the words incident and accident together. And accident investigation in many of the safety and health programs, it is a main component. And it is a very important element because if you want to have a zero accident in a site.

Or if you want to have a complete safe construction site, then you should be having accident investigation as one of the key programs. Because that will help you to analyze the causes of an accident and identify the problems are mesh ups in the way construction work has progressed, and helps you to put a stop to all these unsafe practices in the sites. So, what do you mean by accident investigation?

So, accident investigation is nothing but a procedure to find the causal factors of an accident without finding fault or blaming on someone. Obviously when you are digging out the causes of an accident and going in depth, obviously you may have to point out on someone for a fault or a defect. That somebody has done something, so it may obviously be cornering on someone. But the main purpose of the investigation should not be necessarily in terms of blaming someone, but it is only to avoid any such future accident, so that should be kept in mind every time.

So, what is the main purpose of accident or incident investigation is to prevent a future occurrence, is to prevent a future accident. So, again if you break down that, avoid spending money on accidents in the future which is unnecessary.

To find out why the individual violated the safety policy, maybe there was a head injury, the workers did not wear hard hats, fine. But why did the worker violate that safety policy and did not wear a proper PPE, that should be really investigated and rather than punishing the worker for not wearing the PPE. And when accidents are not reported or they are investigated and analyzed, what happens is the basic cause for which this particular accident was triggered will be

still there and it will not be corrected or rectified or modified. And what happens is it always allows or gives a chance for a future accident to happen any time of the construction work. And next time it can also be very dangerous or very disastrous as an outcome. So, you want to avoid that then a very small an alarming call, you should take it up very seriously and investigate the accidents.

### (Refer Slide Time: 10:01)



So, let us continue with, the steps involved in investigating an accident. So, number one is reporting the occurrence to a designated person in the organization. First of all, you should know whom should you report to, and before that you should also know what are the occurrences which you should report, this we have discussed in the last week class itself. Any death, or a major lost work day cases or resisted workday cases, everything should be reported.

Sometimes if an organization wants to have a zero-accident site and their goal is to achieve that as a very serious goal. Then even near misses and even health issues everything has to be reported. So, during the training and in the safety meetings and safety talks, you should be very clear on what should you report, what point of time, primarily the point of time is just immediately you have to report.

But what are the issues that you should report and bring it to the knowledge of the higher officials that you should know a priori before you start working in the construction sites. And

you should also know whom should you contact and report to? Then provide first aid and medical camp to the injured worker or the team, whoever has got injured. So, more than going really serious into the accident investigation, you should first put off all the dangers, maybe an equipment has run into problem (11:29).

First, you stop the equipment and so on, and give first aid and medical care to the injured workers, inform this to the higher officials. And the general steps by the incident investigation team will start. And those steps are the scene management primarily is to just get the idea of the entire site scene. Then witness management, you can also look at who the workers who were working close to the injured worker, other workers, what happened all pictures, photographs, measurements, videos, everything you should be able to do.

Then investigate the incident and try collecting data by interviewing so many people and so on. Then start analyzing the data and identify the root cause. So, you should look at the same accident or incident in a multiple perspective to identify the real cause for such an incident. Otherwise, it will be this worker operated the equipment and hence this accident happened, and you will be going only to the unsafe act or condition which just triggered this accident.

But you should again go back to the indirect causes or the basic causes of why this accident had happened. Report the findings and recommendations, all these has to be part of the incident investigation personnel. Now once this report is completely done and all angles are analyzed and so on, then the construction organization will have a proper plan as to what should be the corrective action, how should you implement the corrective action and see what is the effect of that corrective action.

Maybe sometimes some corrective action may not rectify the hazard at all and still a very serious issue may also happen. So, you have to also evaluate the effectiveness of a modified course of action under corrective action and make changes for continuous improvement.

(Refer Slide Time: 13:23)



So, that is primarily as a PDCA cycle that has to be done. The first step is a prompt reporting of accidents. So, now if the prompt reporting of accidents itself did not take place, when your accident investigation itself will totally collapse. And as I told what should be reported, one should know and any worker or site supervisor should also know whom should they report to, and what are the incidents that they should report to?

And prompt reporting it is very compulsory for any accident investigation to go in the right direction. Now sometimes what happens is, this prompt reporting of accidents itself will not take place in many construction sites. There are several reasons for workers not reporting an accident, let us discuss the reasons. One is fear of discipline, if I go and say that this particular accident has happened, then the first question that will come to you will be as to why were you there in the scene site, what did you do, what happened, why did you go there and who were all there with you and so on.

So, just for the fear of disciplinary action, and fear of all these red tapes, so the workers will never report any accident, so that is a major cause for not reporting an accident. Then concern about company's record, so too many accidents reporting may also spoil a company's record. That is also another reason why the accidents will not be reported in promptly. The next is concern for company's reputation.

So, the company's reputation also maybe little in danger, so that is also one of the concerns for workers not reporting accidents. Then fear of medical treatment desire to keep personal record clear, if the same organization has other safety programs like incentives and so on, rewards and all for very safe behavior in the construction site. So, just because of reporting an accident may actually will not keep a personal record clear.

And that is also one of the reasons why workers they are very hesitant in reporting accidents. Avoidance of red tapes again and fear of discipline I said they are like together, so just because I am reporting an accident, I maybe called for every investigation and every interrogation. So, some workers they want to avoid and be quiet, so they do not report accidents. Then desire to prevent work interruptions, suppose I just go and complain on something every time I maybe called for interrogations and investigation.

So, there will be work interruptions at each and every point of time, this disturbance may also keep the worker from high productivity. And poor understanding of importance of reporting accidents, that is a main reason why workers do not report accidents. So, first step is to avoid and clear all these barriers and the workers should be encouraged to report accidents. Some suggestions are also given like for example, do not grill the worker or stress the worker, he wants to report for an accident, try to take it up in a positive way and react the situation in a more positive way and you should be appreciating for reporting on time.

So, that future major disastrous events will not have occurred. Make sure every worker knows what kind of accidents should be reported, and what is the importance of reporting accidents in time. And give more attention to prevention and control of accidents rather than blaming someone or try to find faults with someone. Recognize individual performance on reporting all these accidents, and demonstrate the belief by action. Suppose some accidents are reported earlier, if too much of accusations and so on has happened to the worker who reported an accident.

Then obviously workers will not come forward, and one execution has to happen in the sense worker should be appreciated for reporting an incident. And some corrective actions were all done seeing these workers will generally get motivated to report accidents in future. So, investigation do's and don't's that we will see.

### (Refer Slide Time: 17:48)



So, accidents should be investigated as soon as possible after they happen, because the more time the team takes to start the questioning session and the witnesses involved, any witnesses who were involved, what happens is? In the meantime, the workers may try to chat with each other and the one worker's perception may modify another worker's perception. And the total the original scene of the entire accident scene may go lost.

And you will not be getting an accurate story of what happened. So, the workers who were working close to the accident site may have a different picture and workers who are watching the site may have a totally a different picture. So, if you want to get the real picture and understand the root cause analysis, you should be starting the investigation as quickly as possible. And the injured person's version of an accident should be obtained as soon as his practical work and other distractions start minimizing his memory.

And he gets distracted and totally he lost a scene of what happened. So, what happens is, it is generally a human psychology that as time goes, any workers, any human being starts adding up their own imagination also into the scene picture. So, if you want to avoid that and get a proper

scene picture, then any accident investigation should start immediately. There are some occasions wherein you should not quickly start the investigation.

For example, do not question a person just because your interrogation is taking time, is medical treatment is getting delayed then do not even go near the investigation process. Suppose if this investigation is making the worker very upset and he is in totally in pain, and you keep on interrogating him under various situations, then better not to investigate the accident immediately, you can do after he recovers partially, and then you can start doing investigations.

There are various investigative procedures that one should be followed during an investigation. The investigator should have a familiarity on the equipment, operation, process involved. So, first of all you should have a thorough knowledge on the total construction work, so that you will be able to identify the faults and mishaps very quickly. The scope of investigation and size of the team also should be determined based on the nature of the accident, magnitude.

For a very minor case, you may not have bring a big team, but based on the severity of the accident and it is impact, you should be able to bring a big team for investigation. To obtain the accurate facts, the investigator must should start on to the scene as quickly as possible and start his investigation. And whenever any accident is investigated, multiple perceptions of the investigation should be really looked at and multiple causation models also has to be really looked at.

And the real purpose of accident investigation is should be only to identify facts and to have a corrective action rather than a cornering a worker or giving more emphasis and putting on somebody into blame, so that should not be the main motivation. So, what should you do with the actual investigation process?

(Refer Slide Time: 21:24)



So, you should always first think of how should the level of investigation go? Should you have intermediate levels or maybe first level will be only to analyze and understand what happened? Intermediate levels will give you clues and hints, and if you are not able to put all the jigsaw puzzles into one nice story. Then you may have to do 2 or 3 successive rounds in order to have a very accurate picture of what happened, so that you should understand.

And also, the time taken for the investigation also depends on the seriousness of the accident and the effect of the accident on the project team. The next is thing is deciding who will investigate, because investigator should be able to continue with further investigation. Although he meets a dead end, sometimes he starts with a question with a predetermined mindset, he goes starts asking the questions.

And after some time, the witnesses you do not have anything else to continue and so on, then you are actually in a dead end. So, you should always have an investigator who actually know tries to put in dynamic situation and starts interrogating in a different scenario and different perspective. And you should also decide how much time will be allotted, generally fixed time is not good.

If you say within two days the investigation has to be completely done, then you are not going to analyze a real reason for an accident at all. And for major catastrophes to happen, so has happened, the investigation shall start only after the first day treatment and so on. So, time depends on amount of data collected, sometimes if there is too much of confusion and totally a different picture from the witnesses.

And there are so many people involved in the investigation team and so with the as a witness, then you have to have some more time get taken up for the investigation. Sometimes some the cases can be so complicated that you may also have to do some measurements, experiments and so on, then accordingly you can take more time for the investigation. But just because to close the case, you should not be winding up the investigation, identifying someone and finish up the case.

You should be feeling totally confident that you have analyzed all the root causes of the accident causation. So, and also you should also understand whether additional sources are required, for example consultants, maybe even the team itself. Do you want subject matter experts, do you want doctors, lawyers and so on; that you should first of all decide and then start up your investigation.

The next thing is special equipments just for to test something external testing, are you want a specialized computer software to analyze some material and debris and so on. Then accordingly you should also plan for additional resources that are required in the investigation. So, now why do you need special experts?

(Refer Slide Time: 24:27)



Sometimes there may be an in-house accident investigation team to carry out the investigation process. But sometimes the case is, accident is too complicated or it attract the media attention and so on, then obviously you may have to bring in. Or sometimes if the particular accident needs specialized experts and specialized equipment, as mentioned in the previous slide, obviously you need to have special troop and also specialized equipments and software for the investigation process.

Which may include employees with knowledge of the work, supervisors in the area of the work, then health safety personnels, it maybe from the same company or maybe if you want you can bring some other external experts. Then employers with the experience in investigation and representative from local government or police are also required if there is a serious danger and the investigation required.

(Refer Slide Time: 25:27)



How are the facts collected? What are the different forms of collecting evidences from the construction sites, accident? Number 1, physical evidence, physical evidences irrespective of the people in the site. You can take photographs, videos, draw, measure, take physical measurements, whatever you want, that is primarily call physical evidence. The next is witness accounts, so who were all in the close vicinity of the accident.

So, those people's narrative experience on what happened in the accident that will form the second level of data collection. And the third is you can also start prompting questions and asking interviews through discussions and interrogations with various people involved who that in the accident scene. And accordingly, you may have interviewing sessions you may get some more details.

And you can also have open ended questions to trigger out to have and more idea on other directions and perspectives which you have not foreseen earlier. Physical evidence, for example position on the injured worker, position of the faulty equipment, device, safety devices used, position of the control operators, then the damage to equipment, housekeeping area, weather conditions, lighting levels, then noise levels and time of the day at which accident happened.

And you can also take photographs along with written notes before anything is moved, disturbed or modified in the place. And you can also have sketches of the scene based on measurements which can help in later analysis. And if there is any broken equipment debris or any samples of materials involved, that can also be collected for later investigations and testings, test purposes. Witness accounts, now witnesses can be all those people who were there.

And you should also see too that you are not interviewing the witnesses in as a group, you should be trying to call them one after the other. Because as I told you earlier itself, the imagination or the perception of one worker may always disturb the perception of another worker. And if you want to have a correct picture of the complete accident, you should be interviewing the witnesses individually and not in groups.

And the witnesses have the opportunity to discuss the event among themselves, then individual perceptions may go lost. And sometimes the witnesses maybe under severe emotional stress or they maybe also completely scared of talking what happened and so on. So, it is better to encourage them and talk to them, so that let them start opening their mouth and start talking about the accident.

The next interviewing, some of the do's, you should also be putting the workers in a proper comfortable mode, so that they will start speaking and explaining what happened and so on. And if you want to have a statement correct and so on, so better not to corner the worker and try to have a positive side of asking questions. And do not interrupt the when any worker or any the construction personnel are speaking.

And do not prompt for hints and so on, let them speak continuously, so that the multiple perceptions are generally got revealed. And also, one other technique is always trying to keep open ended questions. So, that when these open-ended questions are triggered, it will not have a yes or no answer, then your third perception or a different perception of the entire picture will be received.

(Refer Slide Time: 29:16)



So, investigation process, so the investigator should have maintained a notebook or should be filing up all the scenes completely. So, at the accident scene, so is first to gather all information, so notes on the basic source of written information. And it aids in the investigation process interviews, follow up investigations and so on. If the picture is not clear, then they can actually go back and forth on to the investigation page.

So, all these records should be maintained as a notebook or should be saved in a particular file and as a folder. And the notebook should also have important contact numbers to contact people who want to have more information and more data. And also, basic essentials should be like who was involved, who saw the accident first, who reported the accident and who was interviewed and so on, what happened in the scene site?

And what do witnesses know, what evidence was obtained? What action was taken? And what agencies were all notified? What time did the accident occur? And what time did you arrive? So, primarily from the time at which the accident happened and the time you came to the spot for investigation, all should be considered. Where did the accident occur? Then where were the victims? And where were the witnesses? And where was the individual suspected of causing the accident? All these should be investigated.

When was the victim last seen, when was the suspect last seen? So, all these also should be taken into account. Why did the accident occur, why was this accident reported, all has to be there, with whom was the victim seen and who are the weaknesses connected, how much damage has been done and what is the property lost and so on. So, complete interrogations have to be done and you should have an answer for maybe multiple answers for each and every point.

(Refer Slide Time: 31:20)



Now with this, you can also stop your analysis with one particular cause and finish it up, but why you are looking for root cause analysis. So, generally what happens is, it is necessary to examine all underlying factors in a chain of events that results in an accident. The important point is the straightforward incidence generally you do not have a single cause, it may look very easy and you may also be trying to find out a single cause and finish up the whole case.

But sometimes it may not be so happening, you may have links of events which is linking back to so many issues and which may also be too complicated. So, for example an investigation for a worker carelessness, you can end up an accident investigation saying the worker was careless and so on and that led to an accident, very straightforward case to finish. But you should be trying to identify the multiple scenarios.

For example, why was the worker distracted and what happened and what was the reason for his distraction was a safe work procedure followed or not? And why it was not followed? And why

were the safety devices not in proper order and was the worker trained? If there was no training given to the worker why was a reason behind? So, like this you should be having different perspectives to the same question and just by writing worker was careless and hence this accident occurred.

### (Refer Slide Time: 32:51)



Then last close-out of the investigation. So, after you have done the investigation procedure and you analyze the multiple causes. So, now the next step is you have to document everything and close-out the investigation, why should you document and write it as a report? Because sometimes a future event may or may not happen, future event, you can also go back in seeing what happened earlier and so on.

So, in order to for you yourself as an organization to assess, you should always try to document the investigation. So, now the biggest question to the investigator comes is what happens if it just points on to one worker or a group of workers in terms of human error. As we have seen from the beginning, where every accident is a result of some unwanted happenings. But for example, even a faulty equipment, the equipment poses a hazard but it can lead to an accident only when a worker is going near and doing something.

So, obviously there is a human factor which goes in and intervenes and which triggers an incident to happen. So, it is very difficult to avoid the human issue at all and then bring out the

accident report, so obviously it will be going to be there. One thing when in accident investigation is you should also reveal whether it was done willingly or it was done on purpose or it happened by mistake. That should come out in the investigation process, so that it is very clear.

But if there is an accident which happened with the willingness or knowledge of the worker, then that should be taken up very seriously and you should be the worker should be warned of any such small practices in future. So, how should the follow up day done? So, once the report is documented nicely, it is not that a company wants to have a record and it should be kept in a shelf.

So, the purpose of this investigation should be to think of possible corrective action and in order to avoid a future accident in the near working of the construction progress. So, management is responsible for acting on recommendations in the investigation report, respond to the recommendations in the report. So, first of all, you have to see whatever recommendations are given in the investigation report.

And see whatever is possible and whatever is not possible and you should also analyze why some recommendations are not possible, although they tend to be safe behaviors in the construction practices. And also, you should plan for a very short plan on corrective actions and behaviors. So, that such future accidents will not happen in the near progress of the construction site.

And also check the condition of injured worker, see to that the worker is properly educated and trained, so that he also knows how to work properly in the construction site and help him to get a better replacement job as soon as a worker returns to site. So, these are should be the corrective action from a follow up action after an investigation has happened. Now let me show you one small OSHA document which is available in this reference. (Video Starts: 36:31)

In order to for you to have an idea as to how to do an investigation. So, this is given in the OSHA group of documents, there are so many reports like this, you can go through so that you will have

an idea, how to do the investigation. So, this is investigation of the trench collapse, which happened in 2008 in Miami, Florida. If you see here, so this is the trench collapse which has happened.

And, so this project is a Miami rehabilitation project and if you see in 2018, so the two employees were inside the trench working on the pipe, and the entire concrete barrier wall approximately 121 feet long it collapsed, and killing those two workers inside the trench itself. If you see what happened here, let me go to this you can also read this report later, so this is a site picture of where this trench and the concrete barrier wall showing the trench and concrete barrier wall.

This is a picture which shows the pavement, the shoulder, the barrier wall and below the barrier wall there was flowable fill. If you see the barrier wall after it was excavated, it did not have any underpinning or support, so it was standing as like that, so which led to the collapse of the concrete barrier wall. So, if you see here, so this complete barrier wall, so there was a flowable fill here and which led to the collapse of the wall.

This is again another plan view, so this concrete barrier wall it just got collapsed, these are the other pictures. So, a lot of investigation happened as to why this collapse happened. So, a lot of further investigations on soil samples, what happened? Interviews, investigation, everything happened. And the final conclusion was the cause of the failure was instability of the concrete barrier wall, and the instability was caused by trench excavation operations.

So, these workers wanted to lay the pipes, so they did an excavation, but the trench shows were not that safe, and they also failed to do underpinning of the concrete barrier wall, so as a result the accident took place. So, no support systems such as shoring, bracing or underpinning was provided and the stability of the concrete wall during and after the trench was opened. And there was a violation of OSHA standard, which talks about whenever you have to do an excavation work appropriate shoring, bracing or underpinning of the adjacent structures has to be done. So, it was like they did not take care of the safety rule and there was a violation of the safety rule. And so, they also have not conducted any inspection of the excavation and adjoint areas by the competent personnel, so which is actually required as per the OSHA guidelines. So, these were the reasons which led to the accident, so this is how an accident investigation has to be documented. (Video Ends: 39:52) So, only to show you a sample I brought this, so with this we will stop today's class. Thank you.