Safety in Construction
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Module No # 05
Lecture No # 15
Crane Safety

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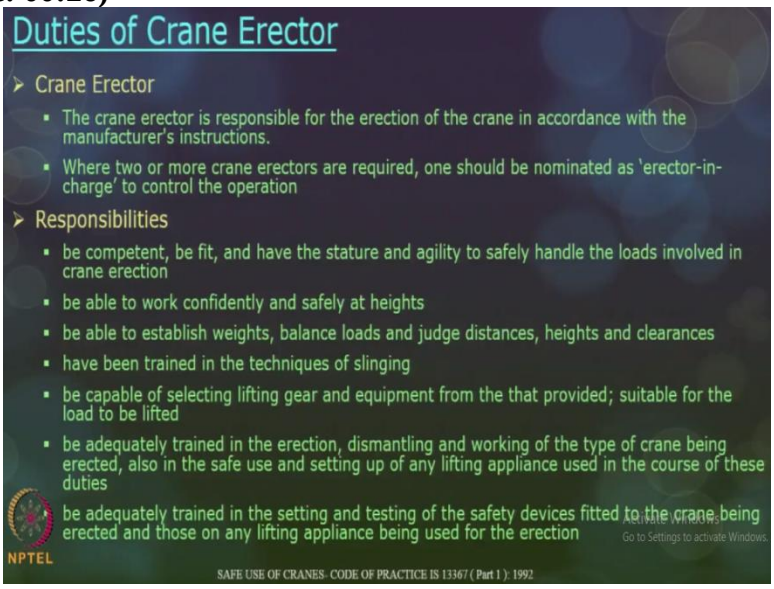

Yes, so this class is primarily on struck by and caught in hazards. So, from that side we have discussed operations like material handling in site and also the piling operations where in crane is predominantly used. So, this hazard is primarily related to crane operations. So, we will be discussing more on crane operation and how safely to operate in today's class. If you see crane there are so many types of crane. And so many ways of handling or using crane in the site. So, covering completely on crane safety will not be possible.

So, I will be covering only a basic safety information with regard to operating crane safely in a construction site. So, now let us start with the class. So, there are so many people who will come in the crane operation. Starting from crane erector, then you will have lift director, then site supervisor, then you may also have crane owner, crane user. So, there are lot of responsibilities assigned to each and every party rigger, slinger and so on.

So, we will be covering the core people who are involved in the crane in proper lifting crane operation. So, number 1 crane erector, so who is called a crane erector? Crane erector is a person

who generally helps in erection of the crane in according with the manufacturer's instructions. So, along with the crane manufacturing you have an instruction, so based on that the person erects a crane he is primarily called crane erector.

So, when a two or more crane erectors are required than you should also have an erector in charge to, control your operation in order to have a proper monitoring of the crane operations. Responsibilities of the crane erector he should be competent, he should be fit enough he should also know how to handle cranes. He should also be able to work confidently and safely at heights so preventing fall hazards and so on.

He should also be able to establish what is the weight? How to balance load, judge a distance, height, clearances and so on. He should be able to manage the complete operations properly. And he should be trained in the techniques of slinging. And he should be adequately trained in erection, dismantling and working of type of crane being erected. And also, in the safe use and setting up of any lifting and appliances in the course of all these duties.

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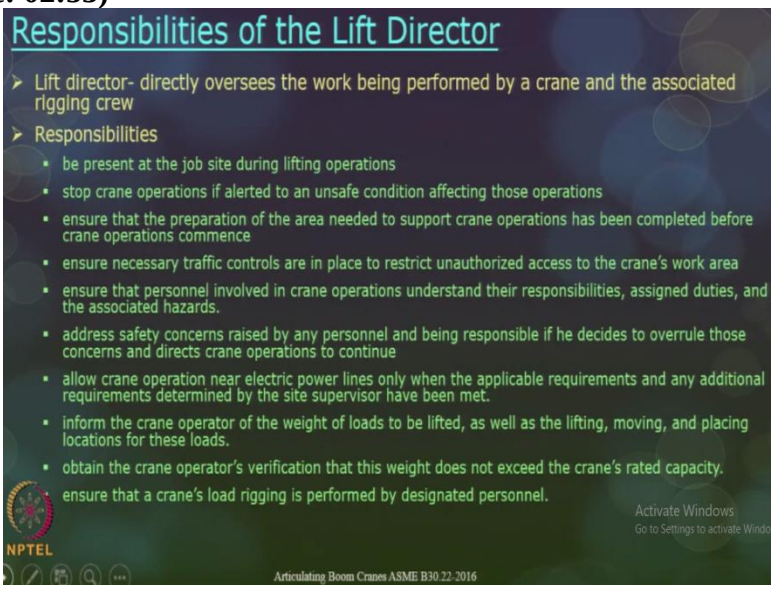

So now let us discuss about lift director. So, lift director he is a person, he over sees the complete operation of the crane and the associated rigging crew. So, he only plans how the lifting has to be done and also executes the lifting operation. His responsibility, he should also be competent, he should be present in the job site during lifting operations. He should stop the crane if any unsafe situations are seen in the site.

Ensure the preparation of area needed to support the crane operations are completed before the crane operations commence. And he should also ensure necessary traffic controls are in place. And ensure the person involved understand their responsibility, they know what they have to do and how the signals are communicated? What are the different hazards available? So, he should be able to be clearly communicating it to everyone.

He should also be addressing safety concern raised by any personal who are in the site and responsible for the safety of all the personal in the site. Allow crane operations near the electrical power lines only when the applicable requirements are met and safe clearance of the electric overhead power lines are also taken care off. Inform the crane operator of the weight of the load lifted, lifting mechanism, moving, placing loads and so on. So, ensure the crane load rigging is performed by the designated personnel. So, he should be aware of everything.

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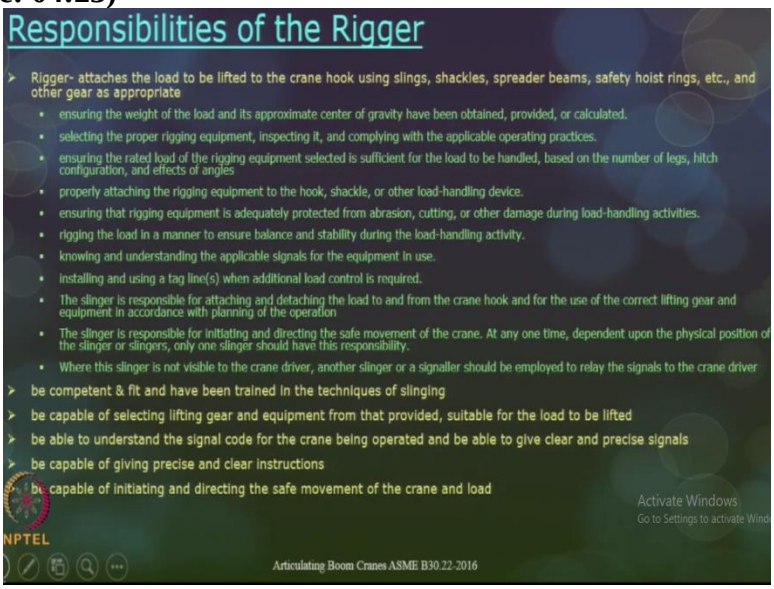

Responsibilities of a Rigger: Rigger is an attached, a load to be lifted to the crane hook using proper slings. So, in some places where they are too many operations carried on so you also refer rigger as slinger also. And along with rigger and slinger you also have a person called signaller. So, something when for small operations these people are may do multiple jobs otherwise there are designated person available for the crane operation.

When there is more than one crane available in a particular site for doing all the lifting operations. The crane operator should really know who is the assigned rigger or the signaller for operating the crane? And he should not be confused with other signalers. And also, the signal

communications and so on he should be very clear before starting the crane operation. And the rigger should be ensuring the weight of the load and approximate center of gravity are all obtained, provided, calculated.

Select the proper rigging equipment, inspecting and compliance with the applicable operating practices. Also properly attaching the rigging equipment, to the hook, or shackle or any other load handling device. Ensure the rigging equipment is adequately protected from abrasion, cutting or any other damage from load handling activities. We will discuss this after few slides. And knowing and understanding the applicable signals for the equipment use and so on.

So, these people should be competent, fit and be trained in techniques of rigging and slinging. And be capable of selecting lifting gear and equipment suitable for the load to be lifted and so on. He should also be able to give precise and clear instructions to the crane operator.

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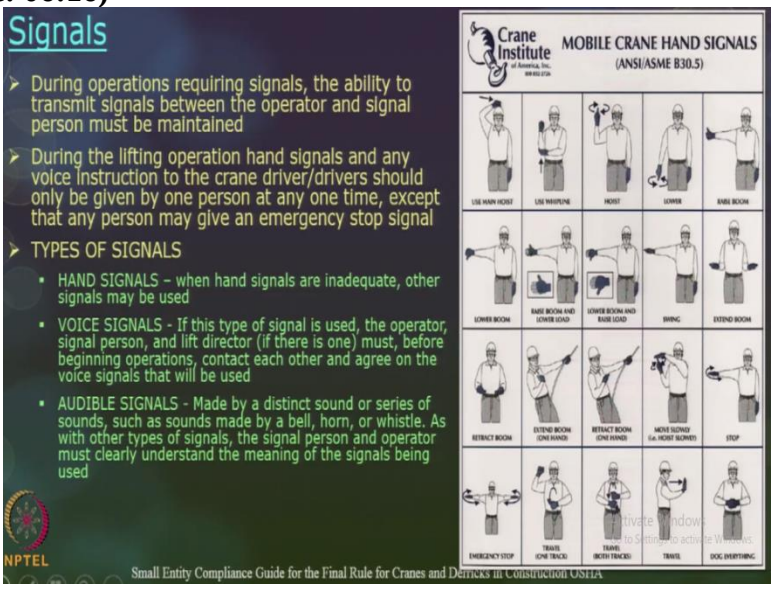

Now what are the signals given by the signaler? So, there are different signals, the main signal in crane operations is hand signal. So, this is developed by Crane Institute of America, so mobile crane hand signals. And there, lot of crane hand signals, so whenever a crane is in operation the crane operator and the signaler should understand the operations signals given very precisely. So, during operations requiring signals the ability to transmit the signals between the operator and the signal person must be maintained.

And there should also be have a common understanding on what is the mode of the signal communication. Whether, it is voice or some sort of an, other device or hand signal. It should be clearly informed and communicated. And also, sometimes a hard copy of the hand signals should be given to the both the parties so that there is no confusion while taking care of the signals. Voice signals if the type of the signals is used voice signal is used.

The operator, signal person and the lift director must before beginning the operations, should understand how the commutations are? And what is the platform used for voice signals? What are the key words which are used? And what is the meaning of those words should be clearly understood. Sometimes there is an audible signal also which is approved which can be in the form of bell, horn, or whistle. And that is also allowed in terms of signals.

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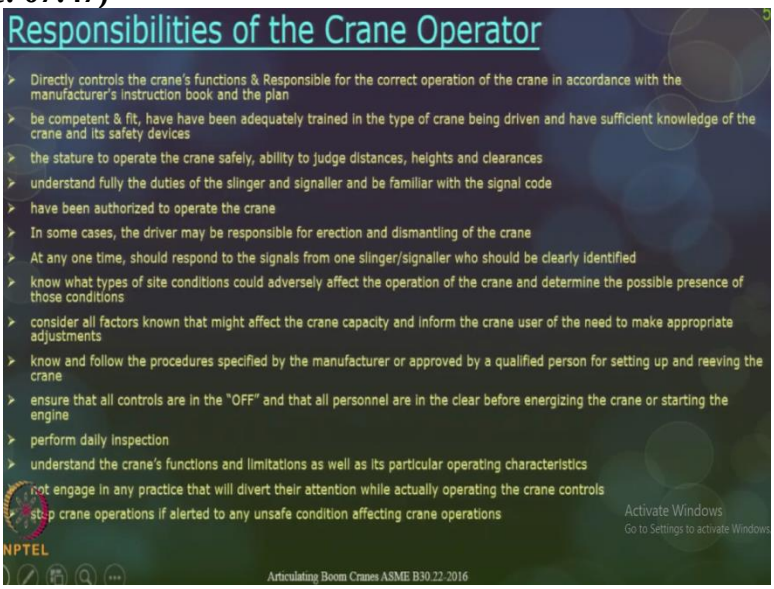

Responsibilities of a Crane Operator: So, crane operator he also called a crane driver. So, he is the person who operates and you know does the complete operations. Sometimes if there are no too many people, crane operator should also be responsible for assembly and disassembly. In the sense setting up the crane and also dismantling the crane operations will also be carried out by the crane operator only.

So, he directly controllers the crane function only and responsible for the correct operations of the crane in accordance with manufacture's instruction book and the plan. He should be competent; he should be fit enough and have adequate training in the type of crane being driven.

Because there are so many types of crane and sufficient knowledge of the crane and safety devices. In the stature to operate the crane safely**,** ability to judge distances, height, clearances.

Understand the full duties of the signaller, slinger and be familiar with signal codes. And should be authorized to operate the crane, he should be physically and mentally fit. Because crane operator's mistakes can lead to very major accidents in sights. The driver may also be responsible for erection and dismantling of the crane at any one point of time. He should be understanding, who are the person who will be communicating with him? And they should be identified.

Know what types of site conditions can adversely affect the crane operation? What site of whether conditions can adversely affect the crane operations? And accordingly, he should put off the crane operations when signal operations are not in good signs. He should be performing daily operations understands the crane's functions and limitations. And you should not get away from the cranes when the crane is on or when the engine is on.

So, then he has to get off then he has to put the engine off and see to that he is having clear surroundings among the personnel and then he is able to do. And stop the cane operations, if alerted by because of any of the unsafe conditions happening in the site.

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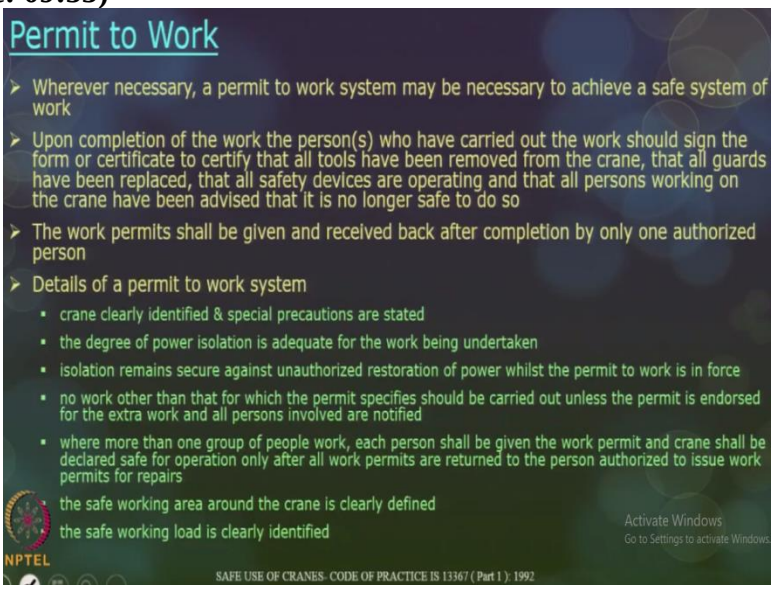

The next is permit to work as seen in the other lectures so there is something as hot work permit and so on. So similarly, we also have in cranes permit to work systems. So, permit to work is

primarily obtained for any operation in the site which is really very complicated or hazardous in nature. So where ever necessary a permit to work system may be necessary to achieve a safe system of work.

Primarily permit to work implies you are evaluating all the hazards and identifying what is the purpose of doing particular task even under hazardous situations? Who is going to do? And what is the nature? How long the person will be able to do? And so on, so primarily it is only for safe operation. So, upon completion of the work the person who has carried out the work should sign the form or the certificate.

To certify that, all the tools have been removed from the crane and all the guards have been replaced, safety devices are all operating. And all persons working on the crane have been advised that is no longer safe to do. So, he has to also be removing all the works. So now the details of a permit to work system the crane is clearly identified the special operations precautions are all mentioned the degree of power isolation is adequate for the work been undertaken.

So, isolating the equipment means secure against unauthorized restoration of powers whilst the permit of work is in forced as so on. So, the safe working load around the crane is clearly identified, the safe working load is clearly understood. And where there are more than one group of people working there each person should be given the work permit. And the crane should be declared safe for operation and then only the crane operation shall start.

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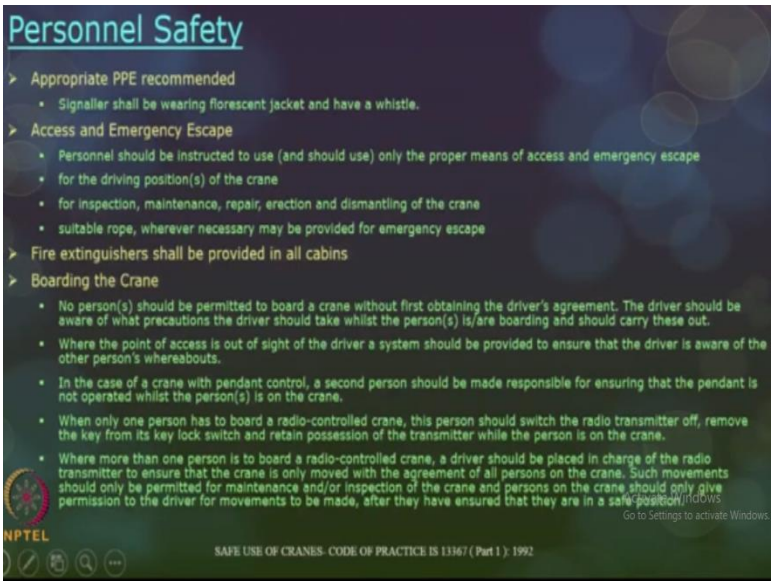

Personnel safety- So appropriate PPEs is recommended starting from fall protection, so there may be hazard on fall protection so you may have to have a proper PPE. And also, the person who is giving the signals, the signaller should be wearing a florescent jacket. And have a whistle so that he is able to be identified by the crane operator. Access and emergency escape, so there can be fire hazard as well.

So, you may have to have a fire extinguisher and also all the precautions of emergency escapes routes and emergency access escapes. Boarding the crane, no person should be permitted to board a crane without obtaining the drivers agreement. The driver should be aware of what precautions the driver should take while the person is on boarding and should carry all of them. When the point of access is out of site of driver a system should be provided to ensure the driver is aware of other persons whereabouts.

Suppose if the person is sitting in a blind spot there should be some sort of television mechanism or something where in the driver is able to see the where about of the other person. In case of crane with pendent control a second person should be made responsible for ensuring the pendent is not operated and the person is on the crane. And where more than one person is to board a radio-controlled crane and a driver should be placed in charge of the radio transmitted.

To ensure the crane is only moved with an agreement of all persons on the crane. And before starting up the crane first of all there is swing radius the complete swing radius should be barricaded so that no personnel is coming into the site of the radius.

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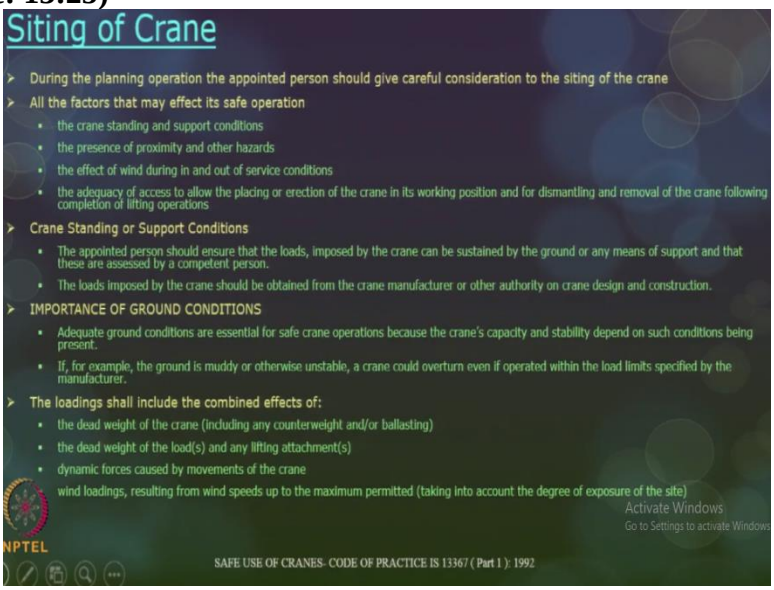

Siting of crane: Siting of crane is primarily setting up the assembly of the crane. So, during the planning operation the appointed person shall give careful consideration for the sitting. So, you should take care of the ground condition, you should take care of other precautions also while you are doing the siting of the crane. So, all the factors, that may affect a safe operation of the crane should be understood.

So, the crane standing position, support condition, presence of proximity and other hazards primarily is it close to overhead power line or maybe there is a building very close by all this has to be understood. Effect of wind also has to be studied, the adequacy of access to allow the placing of erection of crane in its working position. And for dismantling and removing of the crane following the completion of the lifting operations all should be noted down.

And the appointed person should ensure the loads imposed by the crane can be sustained by the ground or by any others means of support and assessed by a competent person. So, whenever a crane is handling a load crane plus the load both are supported by the ground condition. So, the ground condition should be verified whether it is stable for withstanding the load above. The loads imposed by the cranes should be obtained from the crane manufacture to decide on what is the safe load capacity of the crane?

Importance of the ground conditions the Grounds should not be muddy and so on it should be stable it is otherwise unstable the crane should not be assembled in those places. Or it should be

made properly stable and then only the crane assembly has to start. The loading shall include the combined effects of dead weight of the crane. The dead weight of the load any other lifting arrangement including the slings or the rigging practices.

Then, dynamic force caused by the movement of the crane during the swinging and lifting and other operations wind loads if they are any all has to be considered while you are setting up the crane.

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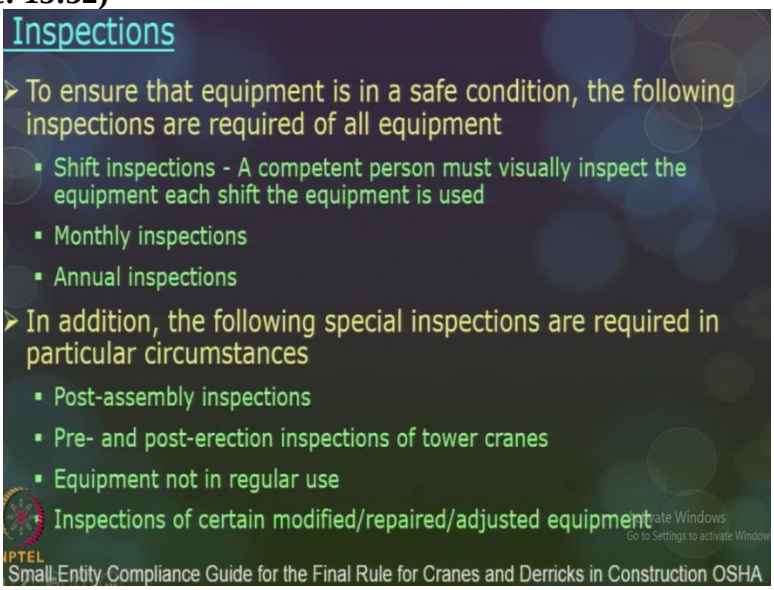

Now whenever the crane operations there are certain precautions or certain routine checks which you have to do before starting up the crane operation. And these inspections are too many in cases of a crane, because crane is very large equipment and accidents due to crane are too many in number. So, the inspections start in routine, the shift inspections, monthly inspections and annual inspects.

Routine the non-routine inspects are post assembly inspections, pre and post erect inspections, equipment which is not in regular use and inspects for certain modified, repaired or adjusted equipments. The routine inspections we will see little elaborately and non-routine inspections. For example, the post assemble inspections are after assembly of a crane you may have to see. Whether the crane can handle the load, is it really safe to load the load and so on.

So, all these precautions you do that is primarily called post assembly inspection. And before and after erecting of erection processes you have to do inspections primarily to check of any wear

and tear or any wakening has happened and so on. So, all these will be inspected when the crane is not in use this regular use is generally referred as 3 months. So, within 3 months the crane is not used than you may have to have detailed and thorough inspections.

Inspections are certain modified or repaired or adjusted equipment. May be some portion of the crane was under repair and it has been repaired or it is modified to suit some extra work and so on. Then again you may have to do a thorough inspection on these circumstances.

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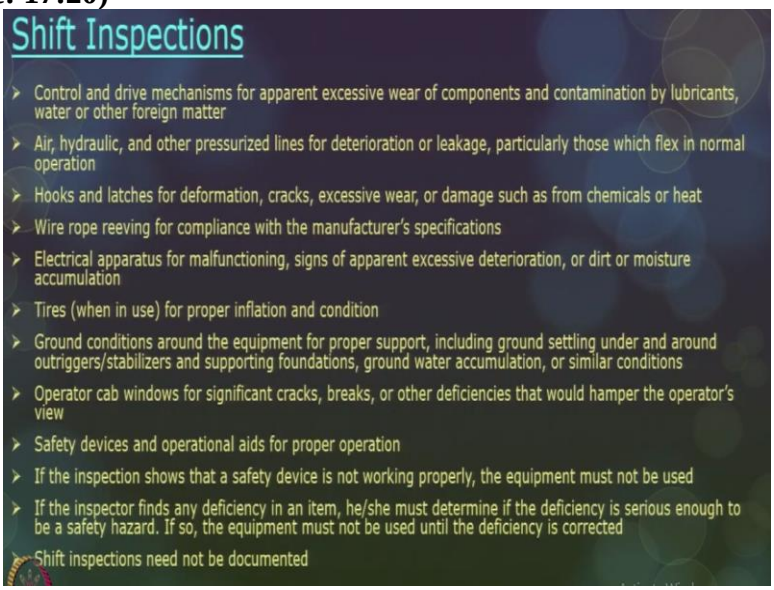

Now, let us talk about routine inspection, number 1 is shift inspection as the name implies after every shift or every piece of work has been handled there is a routine inspection which is carry out. So, this is primarily to control and drive mechanisms for apparent excusive wear of components, contamination of lubricates, water or any other foreign matter. Air, hydraulic and any other pressurized lines for deterioration for leakage and so on will be checked out.

Hooks and latches are primarily inspected for any deformation, cracks, excusive wear or damage due to chemical or heat. Wire ropes are primarily used should be also checked with respective to manufacturer's specifications. Electrical apparatus should be checked for malfunctioning, signs of apparent excessive deterioration, dirt or moisture accumulation. Tires, if they are should be also checked for the inflation and condition.

When the tires are inflated, then obviously you may have overturning of the crane. Ground conditions around the equipment should also be checked for proper support including ground

settlement under or around outriggers, stabilizers and so on. Or maybe we should also look for water accumulation and other similar conditions. Operators cab window should be clean, not seen any cracks breaks or other deficiencies which can disrupt the view of the operator.

Safety devices and operations aids, also has to be checked. There are lot of safety devices and operational aids inside the crane. Which has to be checked based on the criteria given by, the manufacturer. If the inspection shows a safety device is not working properly than that equipment should not be used unless it is repaired. Shift inspections generally are not documented.

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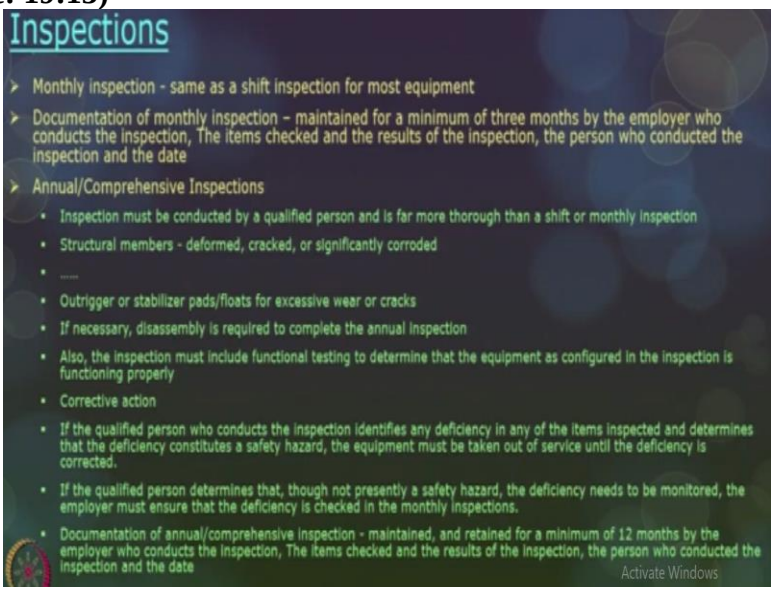

The next is the monthly inspection, so this as the name implies, it is done monthly and this is done similar to shift inspection but it goes for documentation. The documentation of a monthly inspection it maintains for a minimum of 3 months by the employer who conducts the inspection. It also has documentation on what are the items checked, results of the inspections, the person who done the inspection and etc.

Annual or comprehensive inspection is done yearly basis it is far more thorough and done by a real qualified person compared to shift or monthly inspections. Structural members, de-formation, cracking, significantly corroded and so on are all checked. And similarly, lot of other issues which we have seen in the shift inspections, are also done in annual inspections. Outriggers or stabilizers pads, floats are all checked for excessive wear and cracks.

If necessary, sometimes they crane is also disassembled to complete the annual inspection. And also, the inspection must include functional testing. So, bits and pieces of functional testing on load carrying, and rigging capacity and so on are also done sometimes to in order to determine and assess the crane safety. Corrective action also will be done as part of the annual inspections.

If the qualify person who conducts the inspection identified any deficiency in the items inspected. And determines it is not safe to start the crane operation then it has to be taken out for correction. If the qualified person determines that not presently, a safety hazard there are some deficiencies which has to be corrected in a long term that has also to be taken care of and eliminated in the monthly inspection routines.

Documentation so, this is also maintained and retained for a period of minimum 12 months by the employer who conducts the inspection. The items checked the results of the inspection, the person who conducted the inspection, the date on which the inspection done, all these are all documented.

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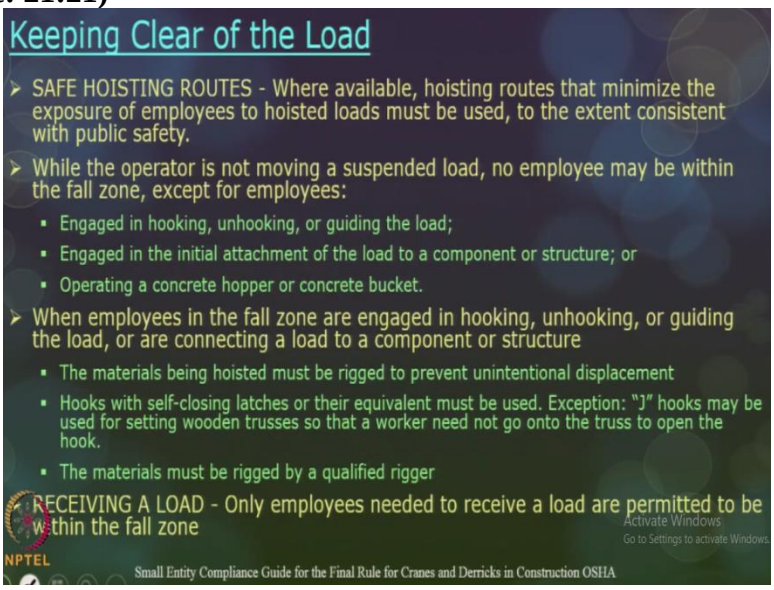

Now, keeping clear of the load as this was discussed in the certain places. Whenever heavy equipments are used or mechanical sort of equipment are used in a site then you have to be keeping away from a safe moving distance of the equipment. So, you have to keep clearing of the load not standing at a suspended load all these basic norms have been discussed in several places. So safe hoisting routes so now when it comes to the crane complete swing radius has to be barricaded and no personnel are supposed to stand there.

Wherever available, even the hoisting routes that minimize the exposure of employees to hoist loads must be used, to the extent consistent with public safety. While the operator is not moving a suspended load, no employee may be within the fall zone. Except for employees, who are engaged in hooking, unhooking or guiding the, load. Engaging in the initial attachment of the load to a component or a structure operating a; concrete hopper or bucket.

Only these people are supposed to stand near a suspended load, because they have to drag the load. For example, a concrete bucket a person has to drag the bucket for pouring in the concrete. When employees in falls zone are engaged in hooking, unhooking or guiding the load then the materials being hoisted must be rigged in order to unintentional displacement. So, the material should not be moving here and there so it has to be completely packed and so on.

He will see what is the rigging practice available? Hooks with safe closing latches or their equivalent must be used when the equipment is hitting on somewhere in the latches should not be open. Self-closing latches should be always used exceptional one the J-hooks may be used for setting wooden trusses so that a worker need not go on to the trust to open the hook. So only some exceptional cases open hooks are allowed.

The materials must be rigged by a qualified rigger. Whenever you are receiving a load, the employees need to receive a load or only permitted to stand within the fall zone. The next issue is safe guarding away from the power lines. Power lines we have discussed enough when you are discussed on excavating equipment and so on. So generally, you will have a safe clearance distance away from the power lines.

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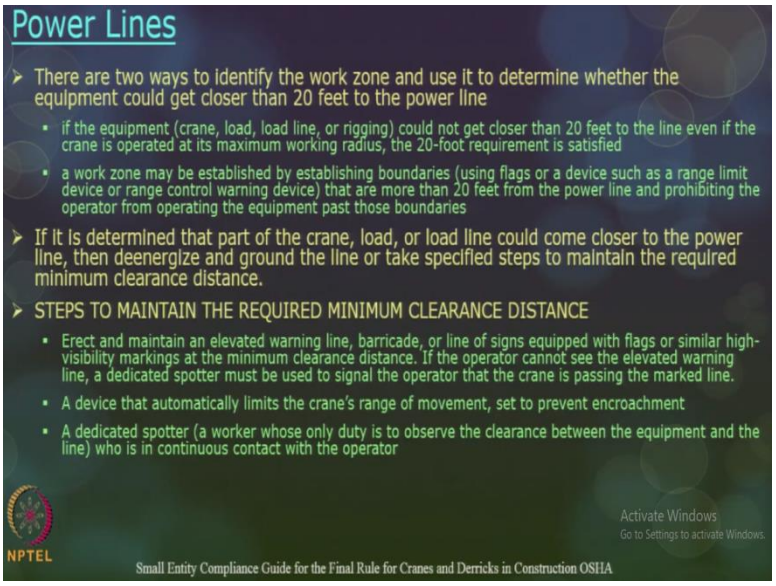

So, if you see what is a power line, minimum clearance with regard to cane operations? So, it is primarily referred as 20 feet away from the power line for any type of work operation. Suppose if you have a clear 20 feet away from the power line then the crane operations can function normally. You need not think of any safety precautions at all, suppose if the crane operation including the crane, load, load line or rigging is very close to the 20 is less than 20 feet proximate distance.

Then you may have to see power what type of load over head power line is? And you have to take care of the clearance. Other way is you can also have a device which can automatically be fitted with the crane, which can also be stopping your power prevent your movement of the crane and restricts the movement if you are very much closer to the maximum reach distance.

And also, you can also have a dedicated spotter whose work job is only to observe the clearance between the equipment and the power line minimum safe distance. So, he will be in continuous contact with the operator, can also be appointed for maintaining the safe distance away from the power line. The other option is you can also have lot of warning lines barricades, line of signs with suitable flags, visible marking.

So that it is very clear the crane operator need not be going till the encroachment area. And the last option which is very feasible you can still think of is de-energize the power lines or ground the lines so that you are actually know safe in working with the over head power lines.

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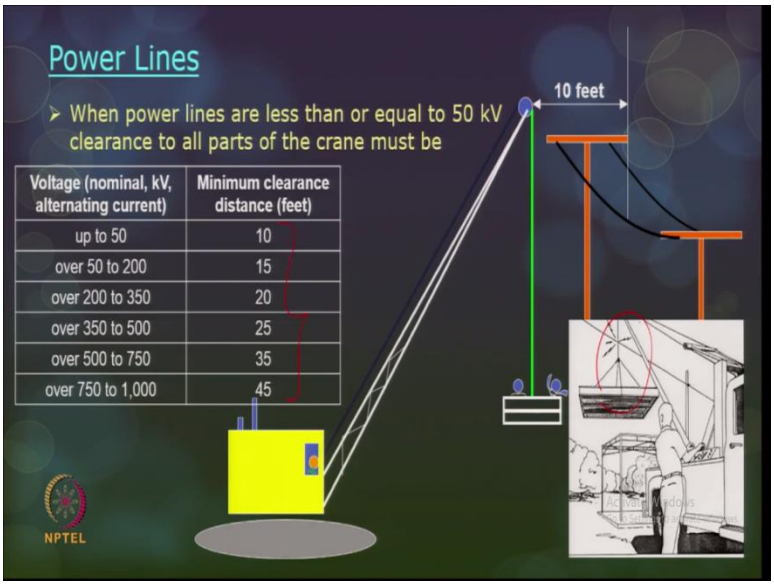

Now if you see the over head power lines you may have a hitting hazard. So primarily this is with the rigging edges got hit with the overhead power line. So, you should have the minimum safe distance away from the power lines. Now based on the clearance, based on the voltage you may have a required clearance distance up to 50 kilo volt 10 feet distance, over 50 to 100 it is 15 feet distance so like this you will a safe clearance distance**.** If nothing is known than you should have a 20 feet clear feet distance away from the power the over head power lines

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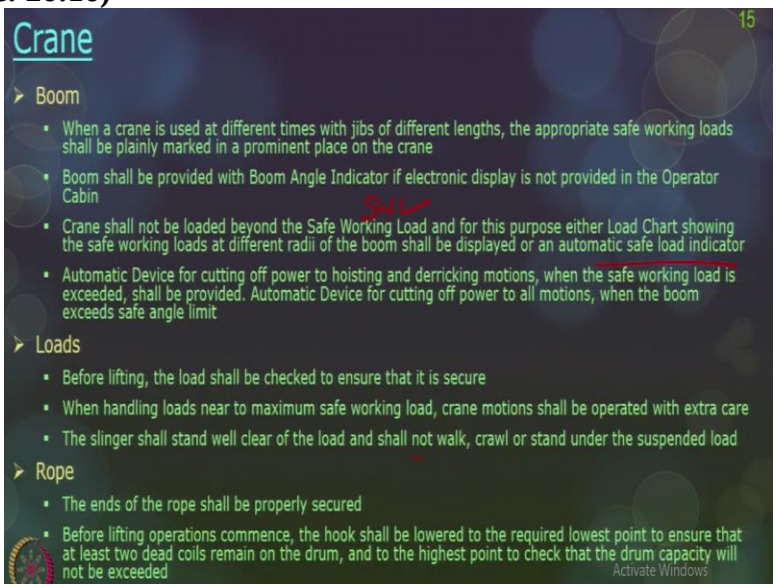

Boom, now the crane parts, primarily the boom crane parts when a crane is used at different times with jibs of different lengths, then the appropriate safe working load shall be plainly marked in a prominent place on the crane. So, it should be visible to the crane operator. And

boom shall be provided with boom angle indicator if electronic display is not provided in the crane cabin. Crane shall not be loaded beyond the safe working load.

Which we normally say as the SWL and for this purpose either the load chart showing the safe working load at different radii of the boom shall be displayed closed to the automatic safe load indicator. The automatic device for cutting of the power to hoisting and derricking motions, when the safe working load is exceeded also should be provided. Loads before lifting the load shall be checked ensure it is safe.

The load also should also be packed so that it is not loose and falling down. When handling loads near to the maximum safe working load the crane motions should be operated with real extra care. The slinger shall stand well clear of the load and shall not walk or move ahead when the load is suspended. The rope also should be properly secured. Actually, OSHA has a separate rope inspection policy also.

Before lifting the operations commence, the hook shall be lowered to the required lowest point to ensure that at least 2 dead coil remains on the drum and the highest point to check that the drum capacity will not be exceeded, this is in case of lifting drums.

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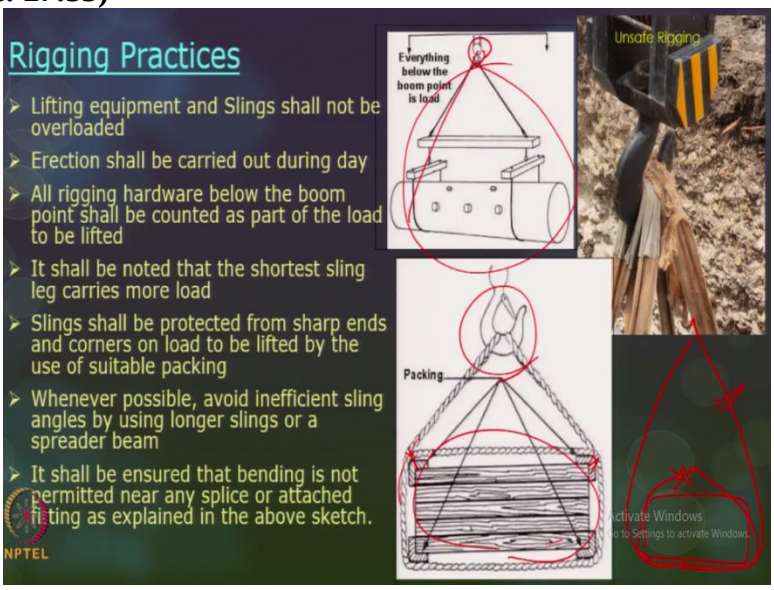

Rigging practices, lifting equipments and slings shall not be over loaded. Erection shall be carried out only with the day light in the day. And all rigging hardware below the boom point and as such below from his all this, points are considered as load acting on the crane. It shall be

noted that the shortest sling leg can carry more load. And as such you can also determine what is the crane load?

And what is the hook capacity or the sling capacity can also be determined with the rate load chart which is also available along with the crane manufacturer. The slings shall be protected from the sharp edges and corners otherwise the slings may be broken by actually suitable packing of the load so that it is not falling off and also its not cutting or preventing wear and tear on to the slings. Whenever possible avoid inefficient sling angles by using longer slings or a spreader beam.

If suppose this is the load to be lifted, do not carry this with a short sling. Better you can think of putting a longer sling. So, this can carry only a half the load compared to this. It shall be ensured the bending is not permitted near any splice or attached fitting.

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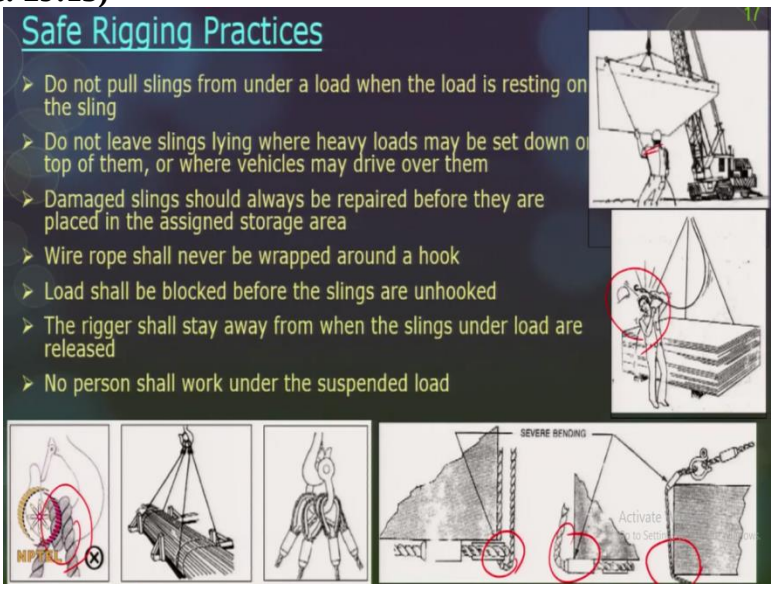

As shown in the sketch here. So, these sharp severe bending are all not allowed in the slinging practices. Do not put slings pull slings from under a load when a load is resting on the sling as shown here. Do not leave the slings lying where heavy loads may be set down on top of them, or where vehicles may drive over them so that the slings are getting damaged. Damaged slings wherever should be repaired before they are placed in the storage area.

And the wire ropes shall never be wrapped around the hook. This is what is wrapping around the hook so this shall not be done. Loads shall be blocked before the slings are unhooked. You

should actually secure the load see to that it is not moving and then only unlock the hooks. The riggers shall stay away when the slings under the load are released. No person shall work under the suspended load to prevent the struck by hazards.

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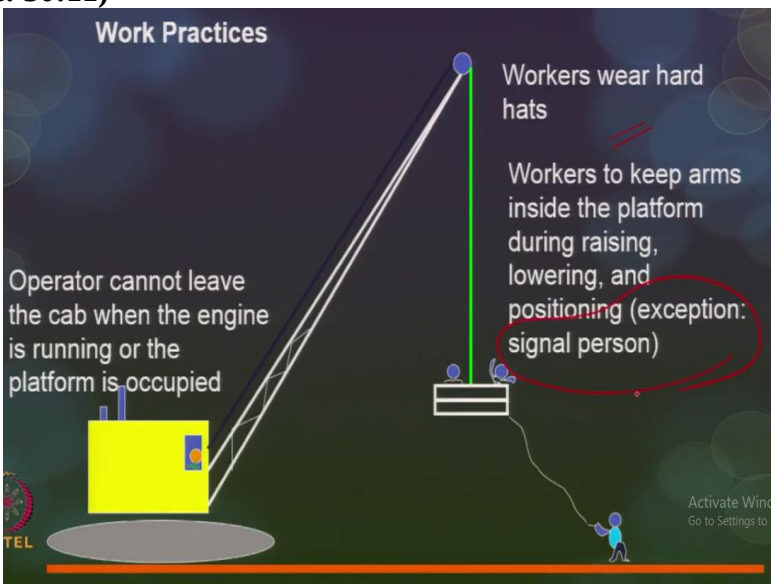

Some of the OSHA practices, operator cannot leave the cab until the engine is running. Engine is running and the platform is occupied so he can leave the cab only when the crane is put in a neutral position. Workers should wear all the PPE including hard hats workers are supposed to keep their arms inside the platform during the raising, lowering, and positioning and so on. Only the signal person are supposed to give signals to the operators.

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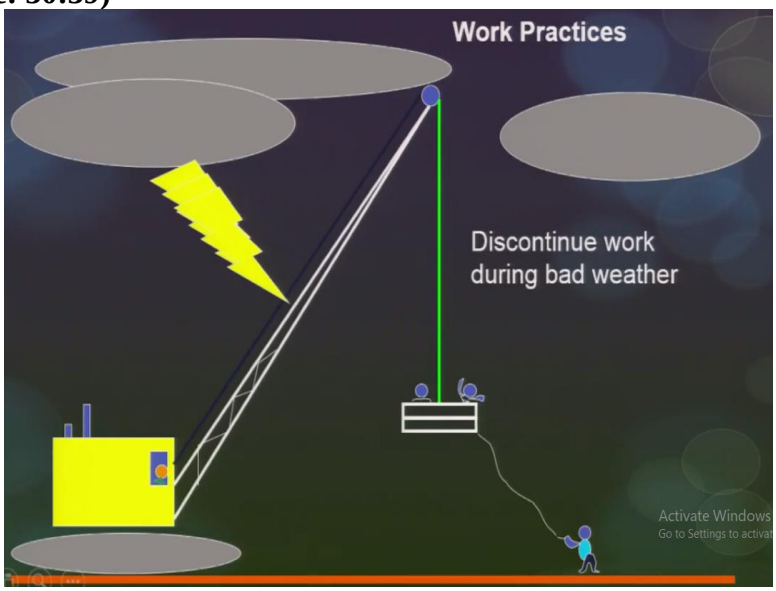

Only in case of emergency, any persons can make the crane operation to stop the crane. Discontinue the work in very bad weather especially when there is rain or lighting and thunder.

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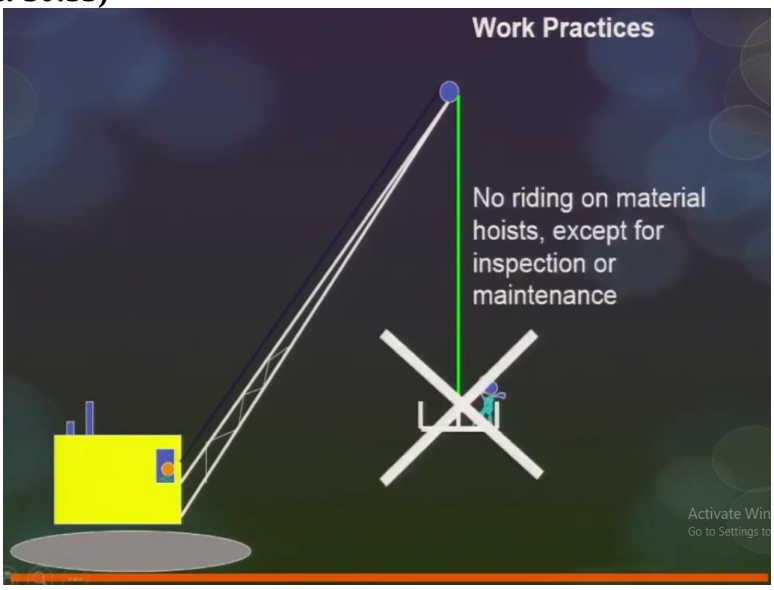

Work practices no riding on the material hoist. Except you can do it, only under the inspection of a maintenance purposes.

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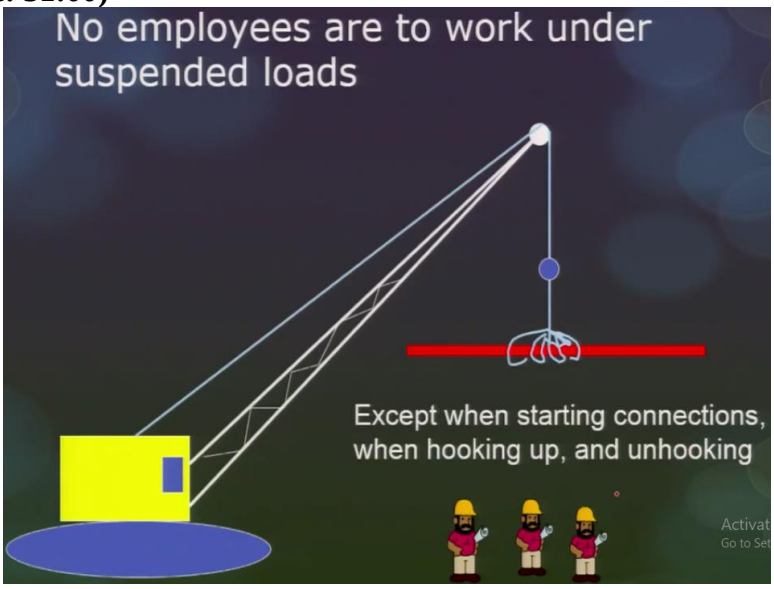

No employees are supposed to work under suspended loads except when you are doing the starting connections when hooking up or unhooking and so on. Then only or while moving the concrete buckets and other issues then only you are supposed to stand.

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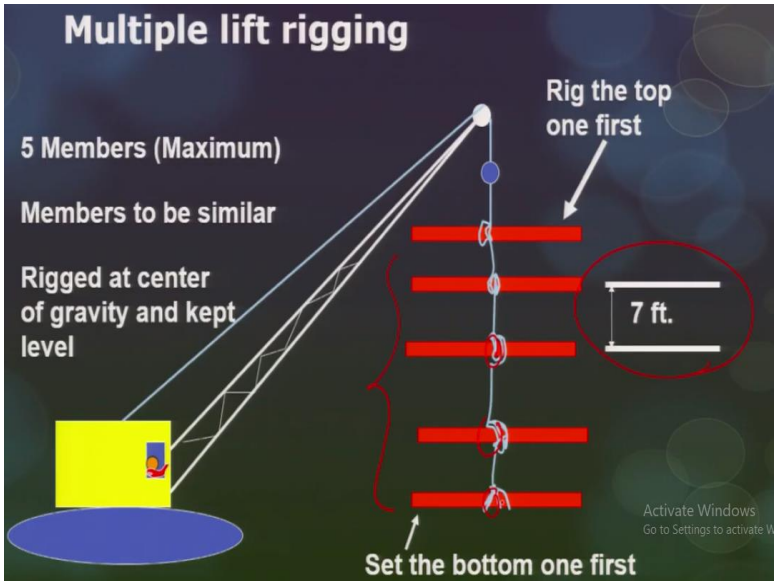

Multiple lift rigging is allowed but may have to be very clear with what are the members you are rigging in the process? 5 members maximum and there should be a clear distance of 7 feet between the members. And the members may be most often should be similar and the rigging should always be done at center of gravity. First of all, you should know where is the center of gravity and tight the rigs along together. And rig the top one first and start digging the bottom one in the last.

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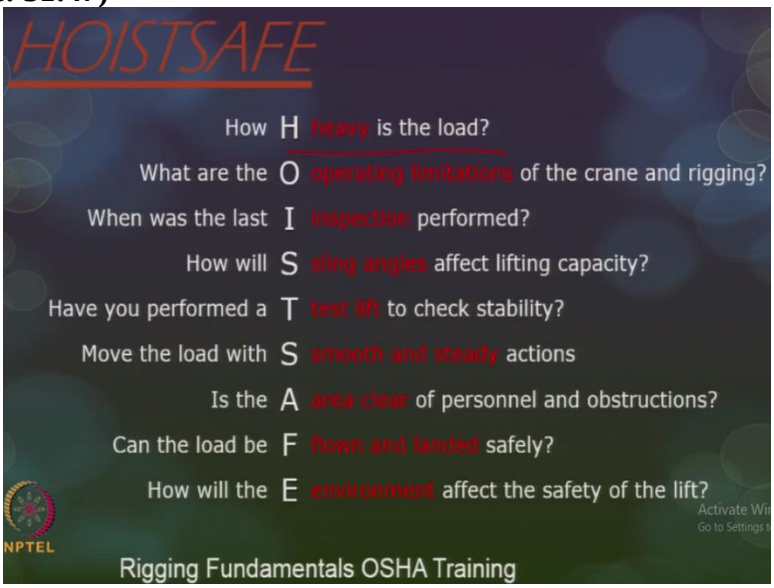

HOISTSAFE this is primarily a snap shot which I have taken from the OSHA training manuals. So HOISTSAFE, so H stands for how heavy is the load? What are the operating limitations of the crane and rigging? When was the last inspection performed? How was the sling angles affect

the lifting capacity? Have you performed a test lift to check stability? Move the load with smooth and steady action.

Is the area clear of personal and instructions? Can the load be flown and landed safely? How will the environment affect the safely of the lift? I think I have covered all of these for hoistsafe operations.

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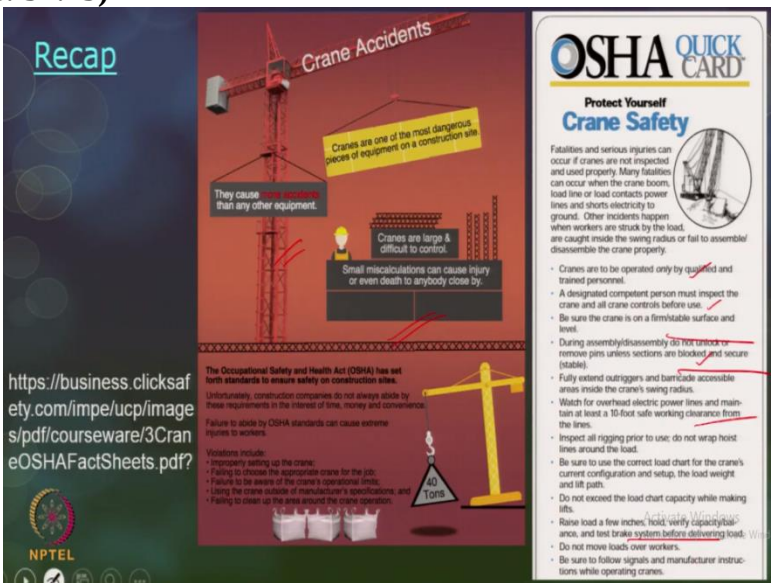

Some more recap, cranes are one of the more dangerous pieces of equipment in a construction site. They cause more accidents than any other equipment seen so far. Cranes are large and difficult to control. Small miscalculations can cause severe injury and even death to anyone who is close by. So, this is OSHA quick card on protect yourself from crane safety. Cranes are to be operated only by qualified and trained personnel.

Designated and competent personnel must inspect the crane on all crane controls before use. Be sure the crane is on a firm or stable surface and level. During this assembly and disassembly, do not unlock or remove pins unless sections are blocked and secure stable. This assembly disassembly operations and safety, I have not covered in this lecture. Actually, there are so many other issues which I have not covered.

And crane safety, if you want to understand completely, there is lot of material available in the public domain. Fully extend outriggers and barricade accessible areas inside the crane's swing radius. Watch for overhead electric power lines and maintain at least a 10-foot safe working

clearance from the lines. Inspect all rigging prior to use and do not wrap hoist lines around the load.

Be sure to use the correct load chart for the crane's current configuration and setup, the load weight and lift path. Do not exceed the load chart capacity while making lifts. Raise the load a few inches, hold, verify capacity, balance, and test brake system before moving and proceeding with delivering the load. Do not move the loads over workers. Be sure to follow signals and manufacturer instructions while operating the cranes.

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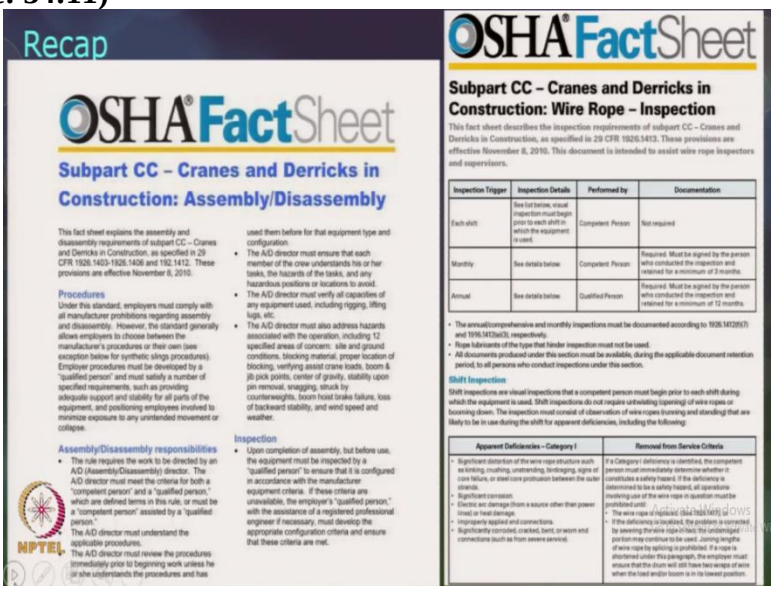

Some more fact sheets cranes and derricks in construction. Assembly, disassembly, Cranes and derricks in construction wire rope inspections.

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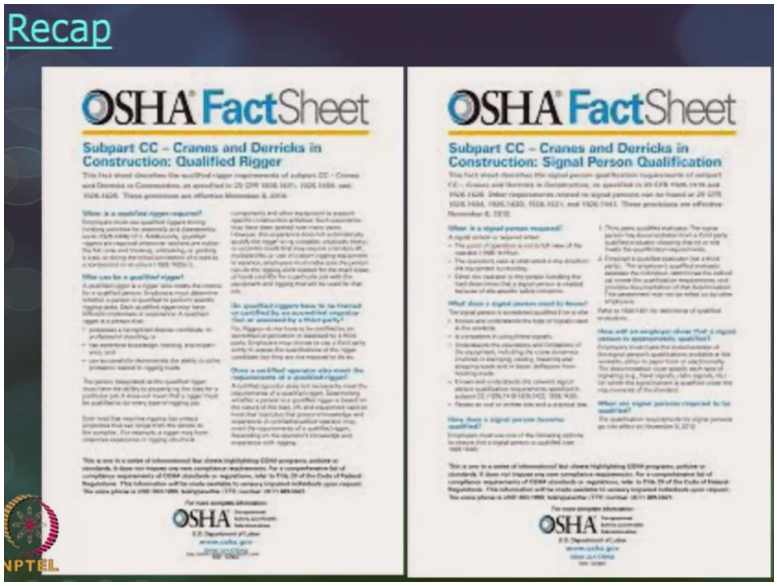

Then cranes and derricks in construction-qualified rigger. Cranes and derricks in construction-signal person qualification. So, like this there are so many documents also available.

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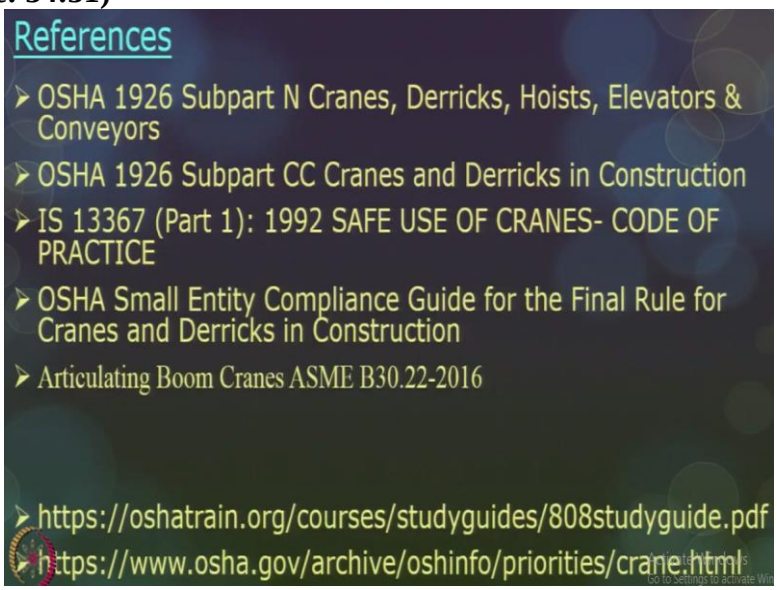

As a quick recap has to follow as a check list when you're operating on cranes and this complete lecture was prepared based on all these documents. OSHA 1926 sub part N; Cranes, Derricks, Hoist, Elevators and Conveyors. And subpart CC Cranes and Derricks in construction. IS code 13367 part 1 1992 on safe use of cranes code of practice and also the other OSHA training manuals and documents. Thank you.