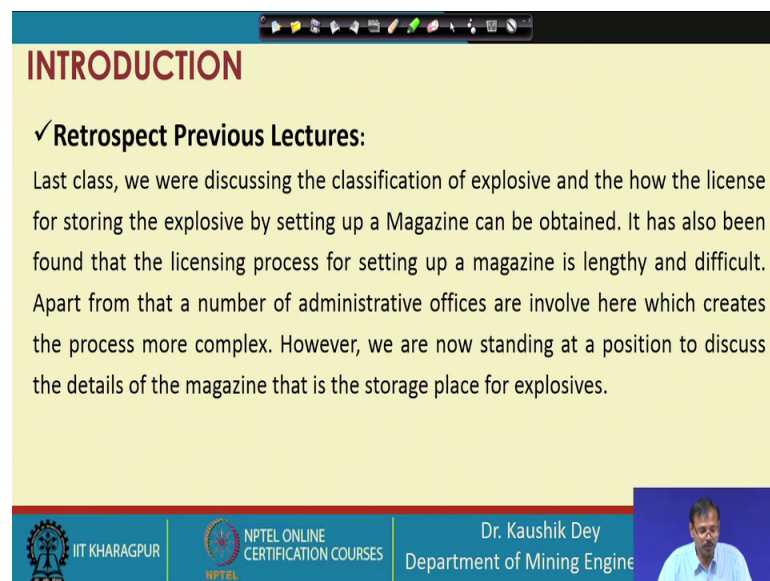


Drilling and Blasting Technology
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Lecture – 27
Explosive storage and transportation-2

Let me welcome you to the lecture number 27 in Drilling and Blasting Technology course. We will continue our topics Explosive storage from the last lecture.

(Refer Slide Time: 00:29)



INTRODUCTION

✓ **Retrospect Previous Lectures:**

Last class, we were discussing the classification of explosive and the how the license for storing the explosive by setting up a Magazine can be obtained. It has also been found that the licensing process for setting up a magazine is lengthy and difficult. Apart from that a number of administrative offices are involve here which creates the process more complex. However, we are now standing at a position to discuss the details of the magazine that is the storage place for explosives.

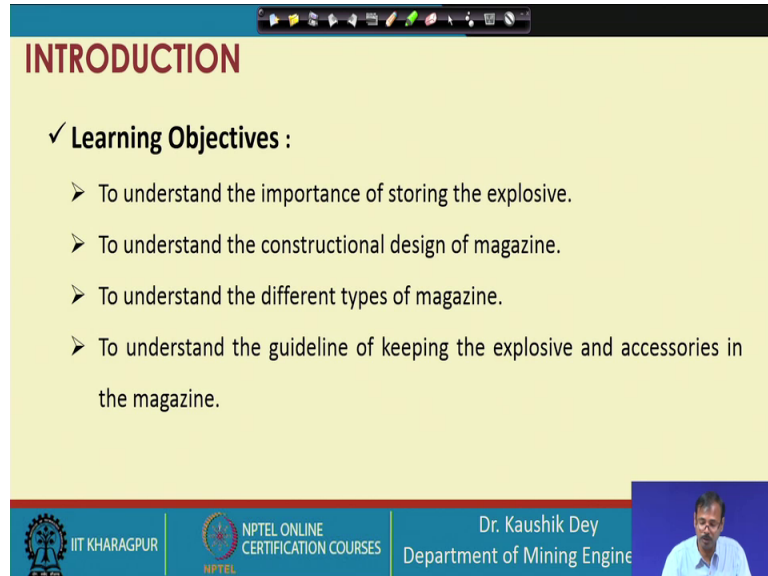
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And in the last lecture, we have discussed the classification of explosive, and the how the license for storing the explosive for setting up A magazine can be obtained, either from the chief controller of the explosive or from the regional controller of the explosive. It has also been found that the licensing process for setting up a magazine is lengthy and difficult also. Specially, you have to take the consent of the local people as the public hearing is there, and NOC has to be obtained from the distinct district authority.

Apart from that a number of administrative officers are also involved. Particularly, say in mining say cases where you are trying to use ANFO emulsions slurry or locks as it comes under the explosive manufacturing. Not only the controller of explosives permission is required, apart from that director general of mine safety's permission is also required. So, it makes a number involvement of the number of administrative

officers makes the processes a little bit complex; however, we are now standing at a position to discuss about the details of the constructional nitty gritty of the magazine.

(Refer Slide Time: 01:45)



INTRODUCTION

✓ **Learning Objectives :**

- To understand the importance of storing the explosive.
- To understand the constructional design of magazine.
- To understand the different types of magazine.
- To understand the guideline of keeping the explosive and accessories in the magazine.

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So, our learning objective remain same from the last class we understand the importance of storing, understand the constitutional design, understand the different types of magazine, understand the guideline of keeping the explosive inside the magazine. So, learning objectives are same. So, like every class let us observe this video. In this video it is showing all the how the magazine is set, what is the there in the nearby position how the fencings are made. So, these are shown and inside how the construction is there. That is also, there inside the (Refer Time: 02:24)

Coasters seeks very urgent today, for the (Refer Time: 02:29) we are talking about fireworks storage. You know, may be some ideas that maybe (Refer Time: 02:37). Anyways here is the grounds around here. As you can see it through you are always praying nothing is cleaned up here. It is been abnormal called way now abnormally called springs we are (Refer Time: 02:47) igniting any fireworks any time soon look at all that dry grass. We do not want to impress the fire very much if we let all some fireworks to set all that (Refer Time: 02:57), it is kind a working around the ground (Refer Time: 03:00) (Refer Time: 03:01).

Do you mind running? That my latest of hobby from last couple fall here. There are couple (Refer Time: 03:10), you got to be careful of some of those obstacles that you can (Refer Time: 03:14) you know, you do not want to; you do not want to do that, you know, and our partner self-down. You go you be careful you know, you do not want to lose down, because that you do not have to give up running and take up cycling (Refer Time: 03:28) disqualified for from your sport for using (Refer Time: 03:32) performance enhancing drugs and you know just your bad deal.

So, any way (Refer Time: 03:36), pretty much the grounds there. Enough and of all that nonsense, but anyway, there is a fireworks magazine. What today we are going to talking about type 4 storage magazine. This one just doing the process would be an approved. I have a federal license for doing a 1.3 o, what people call class B professional grade fireworks, and that is what that is. So, we are going to few days a week or 2, I got signing with my renewal form. So, up to this point I felt rely on the contingency ladder; that means, you can buy the class B stuff, but then you have to shoot it off that day so.

If you get rained out some comes up you can shoot it off, you have to have whoever you are buying from has to have a, you have to have an agreement with them that you can bring this stuff back there until you can use it so. But you can store it unless you have (Refer Time: 04:30) proofed storage. So, that is what that is we just real quickly without wasting much time. And I know this is just a flip that you was going to get the gold (Refer Time: 04:41) out, but have not really got in the attack (Refer Time: 04:45) for that. So, can you see that I have gravel all around it? If I put a little bit more around it. But everything is covered up the way that the agent would wanted to be. So, if they in fact, (Refer Time: 04:57) So, real prize is check it out the next time they come out.

See me which is about once every 3 years some like that. However, that works but anyway getting back to this. Now this is for a professional fireworks storage; however, something to consider I do see on YouTube, that there is a lot of fireworks enthusiasts young (Refer Time: 05:20) out there or whatever doing this (Refer Time: 05:23) videos. Then they have a lot of cases a canister shellers in 500 grams cakes in, you know, consumer fireworks 1.4 grade, but still lot a lot of flammable stuff, and lot of you know this plenty of power there and everything. May be they do not realize is that their home owners insurance would be now on void in any case that they had a fire. And all that stuff going to happen became evident that they had their stuff stored it in there.

So, they might want to consider storage other than in the house. So, my options would be (Refer Time: 05:57) out storage (Refer Time: 05:59) somewhere something that you can keep it locked also where the fireworks stage (Refer Time: 06:02). Or you can consider something like this, but (Refer Time: 06:05) not going to do something like this unless you actually you know going for your federal license. At some point, I will give (Refer Time: 06:11) out there some info, and how you go about doing that. For those who want to actually go down that road, but anyways that is what it is. I will not spend too much time on it.

Can you see that pad locks are they are on the ground, which have come after. So, I can open up the door, and it is going to be all easier, and trying to, ok; even when they are not locked my opinion is to get out of there even (Refer Time: 06:33). That go up to 80 (Refer Time: 06:37) you have a piece of work and you have a pretty hard time cracking them off (Refer Time: 06:42) that is the whole idea of it.

But anyway we have opened it up here. Works right (Refer Time: 06:50) inside. And (Refer Time: 06:53) approved. You can steal our fireworks in there. Now that is one point we professional of course. But what we can do however is stored 1.4.

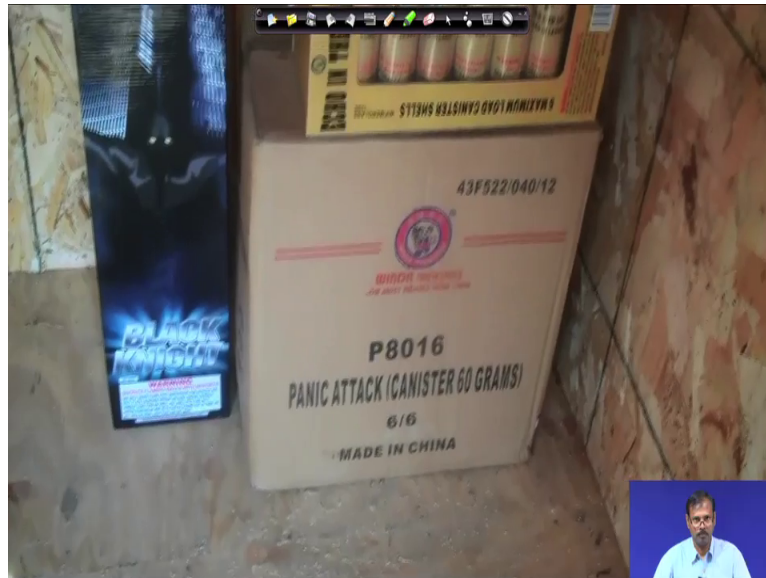
You can see the wooden stick.

Consumer great fireworks what we call class C.

(Refer Time: 07:10)

And all the class C fireworks, you have in there which I do not have too many in there, but there are few of things in there to look at. So, trying to check time on the camera here may be this we get in here more closer to see what time is on our camera. Because yesterday went over and that is (Refer Time: 07:24) pain in (Refer Time: 07:25).

(Refer Slide Time: 07:27)



But anyway you can see we got a few little things in here, not too much. This how bunch of class B fireworks in it a month or 2. They are going to show you, some real stuff some 3 inch shells 2 and half inch shells may be some 4 inch shells, all kinds of goodies, you know. But right now so, we got class C in here. There is some so, my favorite shells are panic attack by wind all those cases those in here. And some things we got a case of it right now. So, do not keep a lot of fireworks around during the winter (Refer Time: 07:47). They are real good, they came out last year they are pretty awesome. You know, cannot report to the x scales I suppose.

I think the breaks are better, and the special effects are being better. Here we have a black knight; you will not probably get those anymore. Because they do not they are not, they were in stores few years ago. And you know they you cannot get them any more (Refer Time: 08:20) they were overloaded whatever, they (Refer Time: 08:22) poured off the shells. But you know they will not allow back in (Refer Time: 08:26) what is 1.4 consumer grade fireworks. So, for that is.



So, this is the small magazine, you can you have observed the constructional details in these. And you have seen there is no metallic content available in inside the magazine or in the contact with the explosive. And that is why the magazines are build up we will discuss all these details in the further slides.

(Refer Slide Time: 08:56)

CLASSIFICATIONS OF MAGAZINE


Magazine can be broadly classified as –

1. Mode 'A' Magazine
2. Portable Magazine
3. Underground Magazine
4. Reserve Stations

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So, as per our requirement the A magazine can be classified broadly classified in 4 types. Mode A magazine, portable or mode B magazine, underground magazine and reserve stations. So, basically magazine can be classified in this 4 groups and the constructional requirement, permission requirements are different for all these 4 types of magazines.

(Refer Slide Time: 09:33)

MODE 'A' MAGAZINE


Magazine must be approved by the Chief Controller and should have –

- walls of reinforced concrete at least 225 mm thick or brick stone at least 450mm and roof reinforced concrete at least 150mm thick.
- Concrete of a minimum compressive strength of 2500 lb/inch²
- interior, and the benches, shelves and fittings constructed or lined or covered to prevent the exposure of any iron or steel to come into contact with explosives.
- one ventilator at the top and bottom in each opposite side wall for ≤ 500 kg and two for > 500 kg.
- The ventilators shall be 22.5 cm.X11. 25cm and of Z type fitted with frame of iron bars.

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So, let us discuss about the first magazine, that is the first type of magazine that is the mode A magazine. So, mode A magazine is the magazine and this is of very large quantity of quantity of explosive can be stored in this magazine. And this type of magazine must be approved, must be approved by the chief controller of explosive. And this type of magazine should have walls if it is of reinforced concrete, then the concrete

walls should have a thickness of 225 millimeter. If it is of brick stone, in that case, it must be of 450 mm thick. And this it must have a concrete roof and the reinforced concrete roof layer should have one 50 mm thick; that means, 6-inch-thick concrete roofing is required.

And this concretes used are here should have a compressive strength of 2500 pound per inch square. All the interiors, the benches, shelves, fittings, constructed or lined should not have any iron or steel which can come into the contact of explosive. So, all the places the explosive should not come into the contact of iron or steel so that prematurely it can be initiated by the induced current in those. So, that is why you have seen in the video also the in the interior, the wooden mats are provided so that it gives the insulation to the explosive from the outer concrete or outer iron whichever is available with that.

So, this is another important point must be carried out while mode A magazine or any type of magazine are being constructed. One ventilator must be provided or one or more ventilator must be provided in to the magazine for ventilating the air inside so that heat cannot be accumulated, and the gases generated from the explosive must be taken out. So, one ventilator is required in the top, and in the side walls. If the capacity of the magazine is less than equal to 500 kg, 2 or more for the more than 500 kg, and this is the specification of the ventilator.

And Z shaped ventilators are always used So that no one can throw any material inside through the ventilators. So, that is why this is essential requirement of being Z shaped for the ventilators which are used in the mode A magazine.

(Refer Slide Time: 13:11)

MODE 'A' MAGAZINE

- external doors-
 - that opens outwards and when closed fit tightly;
 - to be constructed of steel plate of at least 5 mm thick
 - May have internal lining of wood
 - door locks of "dead lock" type
- every internal door-
 - Made of wood;
 - Locks and fittings of non-ferrous metal
- Sufficient windows, openable outward, made of 5 mm steel plate, may have wood lining
- a separate room for storage of detonators or other explosives of Class 6 Division 3 if stored within the magazine
- an internal volume not less than 0.4m^3 for each 100kgs.

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Second next requirements are the doors. There must be a door to enter into the magazine. The door must open outward. We have also seen in the video that door must open into the outward. And it should fit tightly; that means, there should not be any gap between the doors and it is frame so that anyone can be sent through that gap.

So, it should be fit, it should be fitted tightly with the frame. A door must be constructed of steel plate at least 5 mm thick. So, that no one can break it easily, and should have the internal lining of wood. You have seen in that video the door had the internal lining of wood. So, that is the requirement, and the door locks should have a dead lock type you have seen the door was had the dead lock types. So, that no one can easily open the door.

A mode A magazine may have internal door, may not have internal door, that is that may be required may not be required. That depends on that if the internal doors are provided, then the doors should be made of wood, and it locks fittings should be of non-ferrous material; that means, it maybe aluminium or something like that. It should not have the magnetic property. So, that is why it should be of non-ferrous metal must be used for the locks and fittings of that one.

. So, this is the door you have seen in at most care is taken so that the steels yields in the door should not generate any magnetism for generating electricity or immature ignition of the explosive. Sufficient windows must be provided openable windows. Generally, windows are provided so that the light can enter or the, for better illumination inside the

magazine. Windows must be openable outward similar to the door. And again it must be very strong at least 5 mm steel plate will be there for the window.

And again the window should have a wooden line lining so that the plate so that the steel plate will not hinder the immature initiation of the explosive. Say, there must be a separate room of storage of detonator and explosive, of class 3 class 6 division 3 if stored within the magazine. In fact, if the space is not sufficient, then the magazine should different magazine must be there for the explosive and detonators. And if in the same magazine explosives are and detonators are kept, then the separate room must be there for the detonator and explosive, or the significant partition must be there between the detonator and explosives so that the detonator may not initiate the explosion in the explosive.

So, because detonators are electric detonators with the stray current it may initiate it may be initiated the unwilling. So, that is the possibilities of detonation of the detonator is more than the explosive, but the effect of the detonator detonation is local. So, it is strongly unwanted that the detonation of the detonator should not prematurely initiate the explosive, if the explosion occur in the explosive then the result will be very, very severe. So, further for avoiding that we should not keep detonator and the explosive together, then the in any accident the explosion will be very high.

There must be an internal volume not less than 0.4-meter cube should be kept for 100 kgs each 100 kgs of explosive. So, for dissipating heat proper ventilation this much of space must be kept, for as a pre volume for 100 kgs of explosive apart from the spaces available for the movement of the person inside the magazine.

(Refer Slide Time: 17:38)

MODE 'A' MAGAZINE

Fig 6.1, Shows Chanda's Ready Reckoner for ascertaining safety distance norms for different type and capacity of magazines.
(Source : M/s. Industrial Explosives Pvt. Ltd., Nagpur)

Construction (as per Explosives Rules, 1983)

Schedule VIII-It states the 'Safety distances' in tabular form from which are to be observed in the factories licensed for manufacture of explosives or from the magazines licensed for storage of high explosives. (After Pradhan)

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Now this is the safety distance, this is the safety distance bar chart it is available in Pradhan's book. So, the schedule 8 states the safety distances in a tabular form, which are to observe in the factories licensed for manufacturing of explosive, or from the magazine licensed for storage of high explosives. So, these are the magazine capacity. Sorry, these are the magazine capacity; these are the internal safe distance. These are the outside safe distance. And this is the outside safety distance for the rail road. This is outside safety distance for the houses offices factories.

So, this is if you are having this say magazine capacities of 2 ton. Then the internal safety distance is 31 meter for zz category of explosive; that means the most dangerous explosive. There must be 118-meter safety distance from the road rail like that. And there must be 226-meter safe distance is required from the houses offices factories available in the nearby.

So, we have to search out a site which following this criteria for setting up a 2-ton capacity of magazine. So, this is the safe distance requirement. This is the safety distance requirement in the mode A magazine.

(Refer Slide Time: 19:23)

PORTABLE MAGAZINE/MODE 'B' MAGAZINE

Magazine must be approved by the Chief Controller and should have –

- Walls of steel plate at least 5mm thick
- roof of steel plate at least 5mm thick
- Interior lining at least 10 mm thick on walls, doors and ceiling and 25 mm thick on floor and consisting of closed fittings boards or wood joined together in such a way that no iron or steel is exposed on the interior sides, ceiling, floor or doors.
- internal volume not less than 0.65m³ for each 100kg of explosives. The maximum internal volume shall not be more than 2 m³.

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Now, let us look into the portable magazine or mode B magazine. So, mode B magazine must be approved by the chief controller of explosives, and should have the wall of steel plate. So, these are portable magazine. So, this can be moved from one place to another place. So, that is why this will be made of steel plate of at least 5 mm thick.


Roof is also of similar 5 mm thick. Interior lining must be of 10 mm thick on walls doors ceilings with wood fitting boards or woods as you have observed in the video. And there will be no iron or steel exposed to the interior. So, that explosive may come in contact with that. And in this type of magazine, you must provide 0.65-meter cube of interior space for 100 kgs of explosive. You can observe this is little bit higher than the earlier one. The reason is that the it is made of steel plates. So, the intern internal temperature may arises maybe rises more than the concrete type of magazine. And maximum volume shall not exceed 2-meter cube in the inside the per 100 kgs of explosive.

So, this is the requirement has to be followed for the mode B or portable type of magazine which is made of the steel plates.

(Refer Slide Time: 21:10)

PORTABLE MAGAZINE/MODE 'B' MAGAZINE

- ventilation should be provided by means of vents which shall be adequately protected.
- external hinges of steel welded to the door and to the frame of the magazine;
- the lock of 'dead lock' type for external door;
- a coating of anti-corrosive paint in the exterior
- While siting the portable magazine it has to be on a raised ground and maintain a minimum safety distances of 95 m from all houses and buildings and 50m from all public roads, railway tracks, canals, ponds, river banks etc.



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Again we have to provide the ventilation. We have to provide the ventilation by means of vents. And this vents should be of adequately protected. So, these type of vents are in general provided so that no one can send anything inside through those vents. And that is why inside is it will be a protected. External hinges of steel welded to the door and to the frame of the magazine.

That is essentially required; the door should be of dead lock type. And anti-corrosive painting of the exterior is very, very important, because that is as it is steel made. And subjected to rainwater subjected to heat. So, that is why anti corrosive paint coating is essentially required for good conditioning of the steel plate 5 mm steel plate which is used for the construction of this magazine.

So, while sitting the portable magazine. It has to be on a raised ground. It is essentially should be of a raised ground so that the rainwater cannot enter into the magazine very easily. So, it will be on a raised ground, and maintain a minimum safety distance of 95 meter from all houses and buildings, and 50 meter from public roads railway tracks etcetera. So, these portable magazines, you can see the safety distances are also specified like mode A magazine and also the it will be on a raised ground so that rain water cannot come inside. And sufficient protective measures from the atmospheric exposure of the magazine must be taken.

(Refer Slide Time: 23:20)

UNDERGROUND MAGAZINE

As per Explosive Act and Rules, There is no provision for underground magazines in India mines. As per CMR and MMR – “Explosives shall not be stored belowground in a mine except with the approval in writing of chief inspector of Mines and subject to such condition as he may specify therein. Such storage shall be done only in a magazine or magazines duly licensed in accordance with the provisions of the rules made under the Explosives Act, 1884”

- This provision may allow to store explosives for 3-4 weeks’ requirement
- This may avoid the issue and return of explosives at the beginning and end of each shift to the main magazine
- This also requires magazine incharge/keeper in all the three shifts in U/G.
- Chances of pilferage of explosive enroute the magazine and mine is eliminated,
- Instead of carrying explosives in every shift, on weekly rest days bulk of the requirement could be transferred through the cage etc. -

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Now the third type of magazine which is possible in the underground magazine is called magazine underground magazine. As per explosive act and rule, there is no provision of underground magazine in India. As per CMR MMR, that is the coal mine regulation and metal mine regulation. As it is written explosives shall not be stored belowground in a mine, except with the approval of in writing of chief inspector of mines, and subject to such condition as he may specify therein. Such storage shall be done only in A magazine or magazines duly licensed in accordance with the provision of the rules made under explosive act 1884 . so on.

Analyzing this statement, it can be concluded that a mode B type of magazine may be approved by the chief controller of the explosive if it is satisfying the or if it is satisfying all the conditions. And the storage capacity should not exceed the 3 to 4 weeks requirement of that underground mine. And this may avoid the issue and return of explosive at the beginning and end of the each shift. So, there are some benefits of having an underground magazine. And this is this benefits are also good, but the special permission is required in this case. As per the requirement this underground magazine should have a also an incharge for the 3 shifts.

But the benefit is that pilferage of the explosive in enroute in the underground if we are having an underground magazine is eliminated. Because in surface the magazines are at a longer distance where the free spaces are available, then the explosive is coming then entering into the underground for being used. So, this transportation distance is long for the explosive, and pilfering chances are very high. In fact, a number of cases looting of

explosive has occurred in India also. Pilfering of explosive in between is also happened so that can be eliminated.

So, and this will also allowing that instead of carrying explosive in every shift; that means, issuing of explosive at the beginning of the shift from here carrying that manually to the underground. These are being eliminated. So, the safety requirement safety standard will become high, because the manual handling of the explosive is a is became is being reduced in the if we are having an underground magazine.

So, the requirement could be transferred through on weekly rest days thus explosive cannot be on weekly rest days. The explosive may be transferred from the surface to the underground and kept in the kept in the undergrounds. That time no one is no one is there in the cage. So, it is creating a safe better safer condition of using explosive. So, having an underground magazine gives us some benefit.

(Refer Slide Time: 27:00)

RESERVE STATIONS

The places in the underground working identified by the manager for the purpose of keeping or temporary storing explosives. Such places are not

- frequently visited by work personnel,
- Roof is dressed properly of any overhangs,
- properly fenced and contains a sign board stating 'RESERVE STATION'.

They are meant for keeping the securely locked explosives (in containers) and detonator boxes(wooden)issued to the shotfirer/blaster **for use during the shift only.**

The slide includes a hand-drawn diagram of a rectangular structure with a door and a sign, representing a reserve station. The slide footer contains logos for IIT KHARAGPUR, NPTEL ONLINE CERTIFICATION COURSES, and the name Dr. Kaushik Dey, Department of Mining Engine.

Reserve station is also another type of storage place very, very temporary this is very, very temporary storage place of explosive in the underground. The places in the underground working identified by the manager for the purpose of keeping temporary storing of explosive; that means, if there is no underground magazine, the explosive is taken from the surface, then through cage the explosives are transferred to the underground.

This is the manual carrying of the explosive or maybe explosive is carried in a approved type of boxes. Then before sending them to the blasting face say this is the blasting face where it is supposed to be used. So, before sending it up to that because some machine maybe under operation they are may be drilling is carried out there.

So, in that case the temporary storing of the explosive is required. And there must be a reserve station where these explosives are kept for the temporary storage. Till the places become clear for transferring the explosive to the blast place, then blast at there that place and taking out the rest explosive to the surface. So, this temporary storing place of the explosive is called the reserve station, and the reserve station must be identified by the manager.

(Refer Slide Time: 28:33)

RESERVE STATIONS

The places in the underground working identified by the manager for the purpose of keeping or temporary storing explosives. Such places are not –

- frequently visited by work personnel,
- Roof is dressed properly of any overhangs,
- properly fenced and contains a sign board stating 'RESERVE STATION'.

They are meant for keeping the securely locked explosives (in containers) and detonator boxes(wooden)issued to the shotfirer/blaster for use during the shift only.

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This must be identified by the manager, and mark it as the reserve station. This reserve station must be frequently visited by the work personnel so that pilfering of the explosive cannot be done roof must be dressed properly there should not be any overhangs so that that will fall on the explosive and give the shock for the premature blasting of the explosive.

Second is that, it must be white washed. So, that the visibility is very high. And properly fenced and reserve station sign board must be there so that incompetent person should not enter into that place. Only competent person should be allowed. So, these are meant

for keeping the explosive in a secured manner in the containers, and the detonator in the detonating boxes issued to the shotfirer blaster for use during the shift only.

So, this is reserve station over the shift explosive should not be there reserve station will get the explosive in the during the shift hours. And before end of the shift hours, the explosive remaining explosive from the reserve station must be taken out to the surface.

(Refer Slide Time: 29:53)

The slide is titled "TRANSPORTATION OF EXPLOSIVE" in red text. It contains the following text: "Explosives are transferred mainly between –", followed by two numbered items: "(i) Manufacturer site to user magazine and return (occasionally)" and "(ii) User magazine to site of use ad return." Below this, a blue box contains the text "As per Explosives Rules, the transportation of explosive can be done by –". This is followed by two sub-points: "a) Road van - carrying capacity restricted to 10 tonne/max. van load (whichever is less)" and "b) Railway Wagon - carrying capacity restricted to 10 tonne, half of max. wagon load (whichever is less)". A separate box at the bottom states "License of the transportation is issued by CCOE". The slide footer includes logos for IIT KHARAGPUR, NPTEL ONLINE CERTIFICATION COURSES, and a photo of Dr. Kaushik Dey, Department of Mining Engine.

Next is transportation of explosive. Transportation of explosive is carried out twice, from the manufacturer site to the users magazine, and users magazine zine to the site of use. As per explosive rule transportation can be carried out by a road van by a railway wagon. And carrying capacity for the road van is 10-ton maximum or the van load whichever is the less. And for railway wagon it is 10 ton or half of the maximum wagon, wagon load whichever is the less.

And for this transportation license must be taken from the chief controller of explosive, and after considering a number of constructional requirements chief controller of explosive will allow this one.

(Refer Slide Time: 30:48)

TRANSPORTATION OF EXPLOSIVE

- Same vehicle can not be used for transporting Explosive and detonators. If required, some special vehicles should be used for the same – separate compartment.
- Not more than 200 detonators are transported at a time
- Explosives and detonators should have their original casing during transportation
- Max. vehicle speed 25 km/hr.
- For transporting in underground drive/drift/stope/district or through shaft/winze/raise, a person can take max. 25 kg in his bag (blaster, blasting crew)

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Same vehicle cannot be used for transporting the explosive and detonators. If required special vehicles may be manufactured where the separate compartments are there for the explosive and detonators not more than 200 detonators are transported at a time. Explosive and detonator should have their original casing during the transportation. So, it is not that, it has to be taken out from the original casing and placed in some other casing.

Vehicle maximum speed should not exceed 20 kilometer per hour. And for transporting it in the underground drive drift stope a person in his felt back can take maximum 25 kgs. And the person must be a blaster or blasting crew members which is who is a competent person.

(Refer Slide Time: 31:51)

MORE READING FROM

✓ **Reference books:**

- Explosive rules ✓
- Explosive Acts ✓
- Pradhan G. K. 1996, *Explosives and Blasting Techniques*, Minetech Publication ✓
- SME Handbook ✓

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So, there are other n number of nitigrities are there in the transportation of explosive. It is not possible to put everything inside this lecture, but it is desired that you may carry on the additional reading in the on the explosive rules, explosive rules explosive acts these books so that get the details nitty gritty about the transportation of explosive.

So, this is the end of our topic storage and transportation of the explosive. And so, from this 2 lectures I expect that you are able to understand how the explosive can be stored. What are the classifications of the magazines in which magazine how much explosives and detonators can be stored, and how the license for those can be obtained, and how the explosive can be transferred what are the security requirements there. That must be studied by you from these recommended literatures. So, I think this is the end of this lecture.

Thank you.