Introduction to Engineering Seismology
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Module No # 03
Lecture No # 14
Seismic Instrumentation in India (contd)

So vanakkam we will start our; discuss on the seismic instrumentation in India. So we discussed that we have been very poor instrumentation even until 1960. After 1960 we have been engaged in the several other institutes to support seismic station networking in the India. That has several institutes ok the government institute, state level institute and the government dam managing agencies and all step in and try to build a local seismic network or regional network.

We have also seen that among the many of the regional network very few people add a broadband seismometer. So, most of them basically add a vertical component single size component seismometer which may not be so much useful for engineering application. And we also discussed that there was a lack of proper seismic data's ok in the country because of this are the region. So; this has been visualized and then understand by the ministry of earth science.

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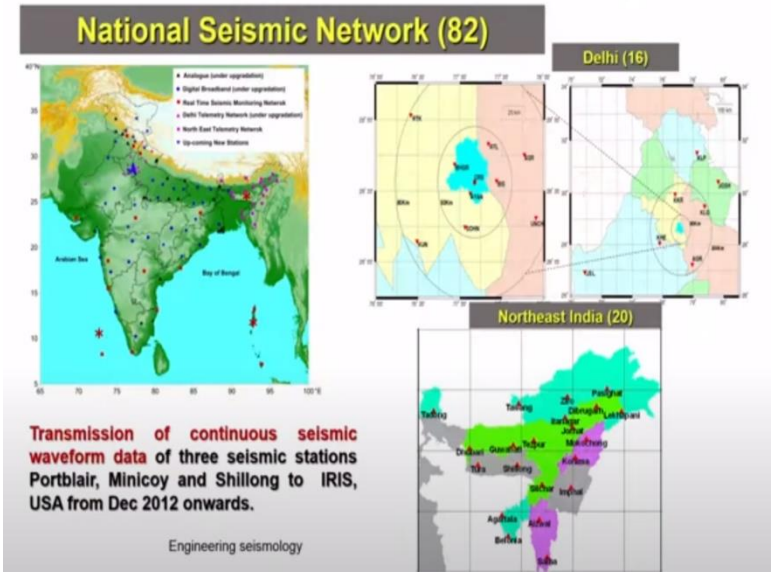

So then they start building a very good seismic network in the country after 2001 Burj earthquake it triggered alarm to the many of the people try to first thing to understand the earthquake is basically measuring the earthquake and understanding where it occurs how the

ways are propagating as we have seen the preparedness for the earthquake risk reduction is the understanding of the earthquake.

So if you look at as on now ok so you can see the India map where there was a seismic stations marked throughout the country. So you can see basically so how the seismic stations are so you can see here ok. So this is basically Delhi ok so Delhi they maintain their own Delhi regional seismic network. So you can see the Delhi region and you can see how many, number of earthquakes are reported.

So this may be the reason that whenever there is even a small earthquake are occurring you can get immediately recorded and reported because they have the considerable more number of seismic station than any other big cities in India ok Delhi. So the, another network what they maintain is a regional network is actually a north east you can see a north east. So, even though the north east as a 7 states but each state at least they have the 2 3 seismometer.

So when compare to this smaller area the number of station fixed here are more than compared to other part of the India ok. This is also some kind of regional dense network you can take but since it has a large variation of the topography as well as the geological formation ok. So this number of station in the region itself may not be sufficient according to the international station requirement. So if you look at the India ok you can see the number of station.

So you can if you zoom into the closer to southern India you can see the India there was actually very few stations are located in the southern part of the India. So the lack of number of station basically lead; to less number of micro earthquake recordings. Basically there may be earthquake since you do not have the instrumentation there you cannot be recorded. Since there is no recorder so you should not feel that there is no seismic activity in that region.

So until you have the very good seismic network then there is no earthquake recorded for the past 50 years, 100 years you cannot classify particular region as a low seismicity without having the instrumentation ok. There are many places where the vibrations are felt ok. So it has been reported in the newspaper or local TV channels but there is no seismic record near to that. So many times far away station which may not be able to pick-up.

For example if you are seismic station regional network station are the earthquake short period sensors are available at a distance ok more than the twice depth of earthquake it may not record those earthquakes. So that is a limitation so with that limitation you can see that the number of station is this map. So there are still some analog stations are being monitored in the country. You can see where and all analog station is there. For example this one and this one these are all the analog station.

For example this one and this one these are all the analog stations. Then the digital broadband station so the blue ones are the digital broadband stations. You can see that these stations are relatively central and northern part relatively distributed well. So the real time monitoring seismic monitoring network which basically communicate with the satellite and try to for transform data to the this one.

So this is the Delhi network where the purple triangle and this is the north east network where this one so this is the seismic network in the station where now even, the IMD working towards to improve the stations. So this is as on December 2012 ok seismic station December. So now there are some station are upgraded and some stations are basically isolated.

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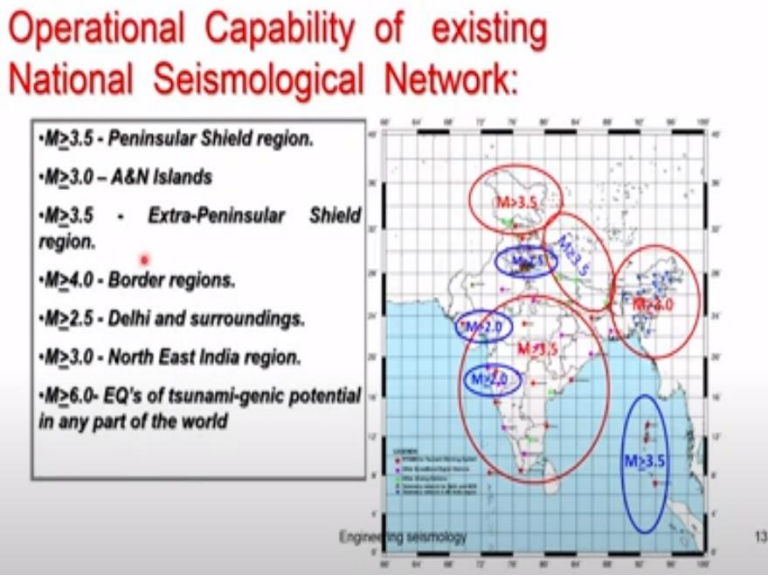

So as on this network you can see what earthquake you can record and what regions. For example if you look at this portion so this region also part of India where you can get any earthquake which is more than 3.5 magnitudes. This is basically these are all may be the

acceleration sensors. So then this region anything again more than 3 you can felt 3.5 this region 3.5, 2.5 so 2 and 2 and overall 3.5. So most of the seismic session what ever is there the lowest magnitude what we can record was around 2.5 and above.

So which actually makes basically make a question if there is a earthquake occurring less than 2 it may not be pickuped by your seismic session and even human may not feel this earthquake. So those, kind of seismic activity if it is not noticed it very difficult to understand this region are seismically active or in active because of the lack of sensitive earthquake records. So this is a state of part instrumentation in India.

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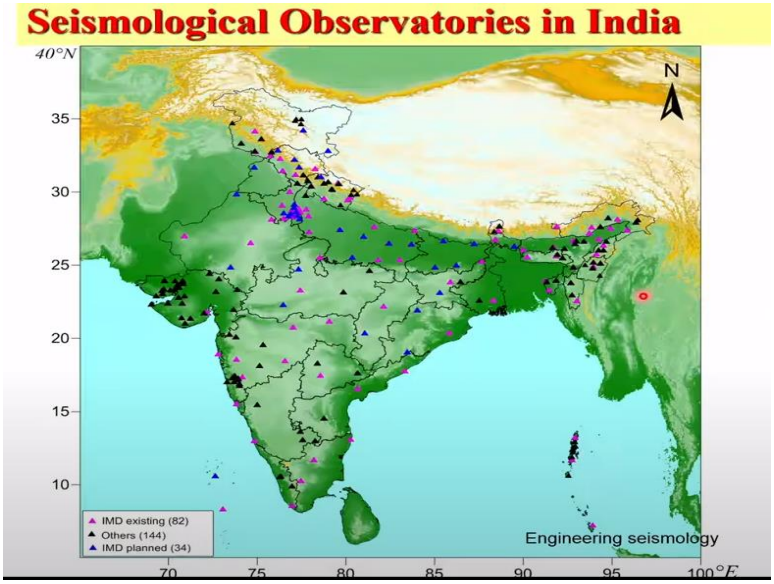

So you can see the same kind of data in the bigger scale. So where the existing IMD equipments then the other IMD planned few more stations. You can see basically they are planning to upgrade so fill the gap in southern part more and also add many station on the this one northern part. So all this seismic observatory; how it works presently because the governments try to update and try to modernize the seismic station continuously with IMD leadership.

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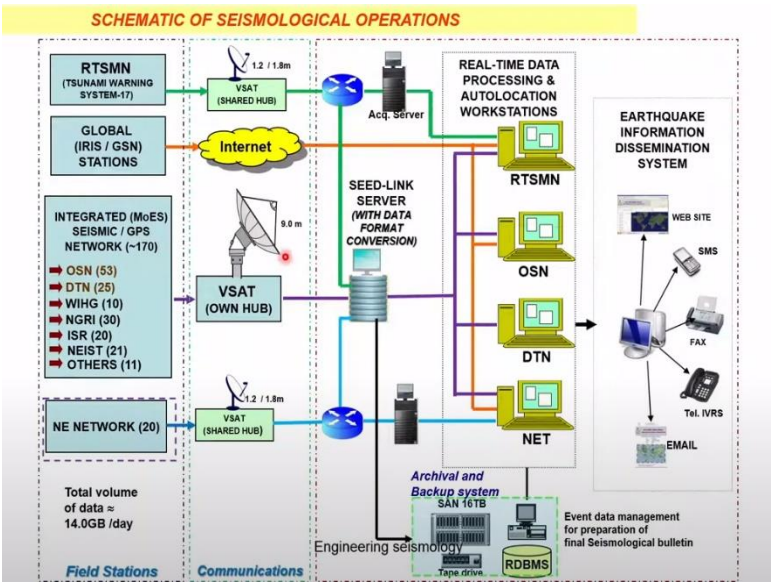

So basically how this stations are working. So all this stations now they are making completely digital ok. So what it does basically it records earthquake ok then send it to the computer in the particular place that computer sends signal to the nearby satellite station. From the satellite station it is send to the satellite. And from the satellite it again comes to the other computers and network in the system ok.

So based on this magnitude level of magnitude and PGA it also sends warning to the people who are registered their names for knowing the earthquake. So that means if there was a big earthquake you will get to know from the your SMS or email or phone call this is the earthquake occurred on this region which is very important particularly to disaster, evacuation and planning and also to stop some of the travel all those.

For example there was big earthquake in the Delhi then soon after the earthquake the people know that the earthquake occurred so immediately you can re route the flight which will land on the Delhi airport assuming that there is a situation is bad. And how the airport might be damage you can know the size of the earthquake. Then visualize that how the infrastructure in that particular place and possible to land or not. So accordingly you should reschedule.

So those are the preventive measures and reduction of hazard can be taken up effectively when you have the this kind of station ok so communication and then the basically sitting with

computer and then try to disseminate a knowledge in the longer larger group of people ok. So that was the arrangement now it is available.

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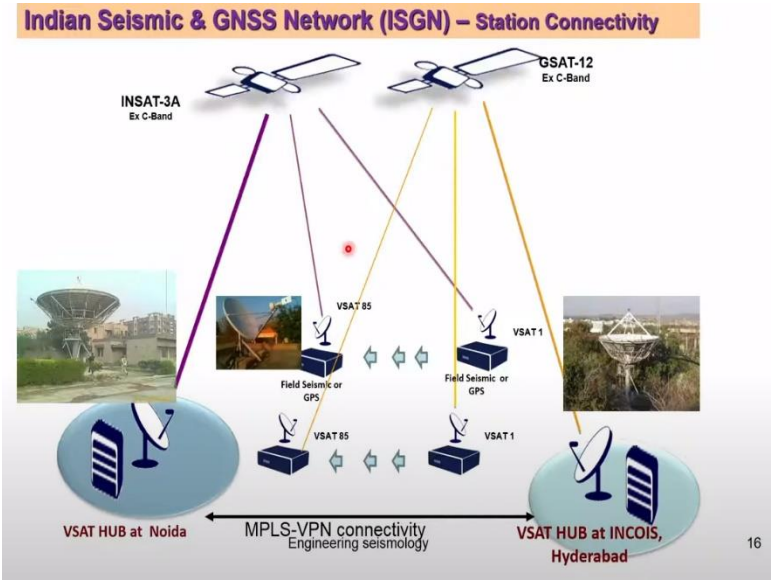

So this is how it works basically you can see so the seismic station will record and then transfer to the controlled system where is this Noida there is a hub then it gets transferred to the satellite from satellite going to the all the around people. So all of them basically controlled by the so satellite based system where even your local networks are affected it can be effectively work ok. So other than your communication but the data other things may not be lost.

So they are some of the permanent satellite station in the country where you can get direct communication of the satellite and transfer a data and receive a data. So this some of the station is actually even close to Bangalore there is 1 station and close to Delhi there is a 1 such station where I was actually acting as a consultant to design of getting a dynamic properties to design this satellite station ok. So a part of Trinetra project so that time I could I have seen all these things as a.

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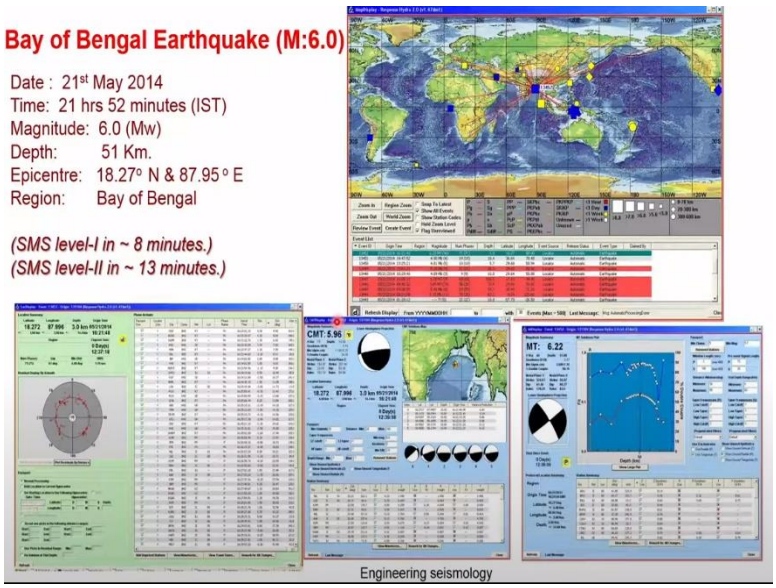

So right now so you can get the IMD website you can see where the earthquakes are occurring. What is the magnitude? What is the depth? Ok. So what is the time period you will get SMS actually SMS can be received level 1 by 8 minute level 2 by the 13 minutes. So if you access the website you can see like how the source and what are the station it is recorded. So using the data you can try to estimate what is the location of the earthquake the epicenter the depth of the earthquake and then the focal mechanism ok that also is you get.

And you will also get the shake mapping and then this earthquake how many stations are recorded also you will be coming to know they have the software which is integrated with the national level as well as the international level kind of things. Where the particular earthquake can display this one earthquake? This is the Bay of Bengal earthquake 6 magnitude where the soon of this like when it is occurred what are this one when it was alarm issued details are given here.

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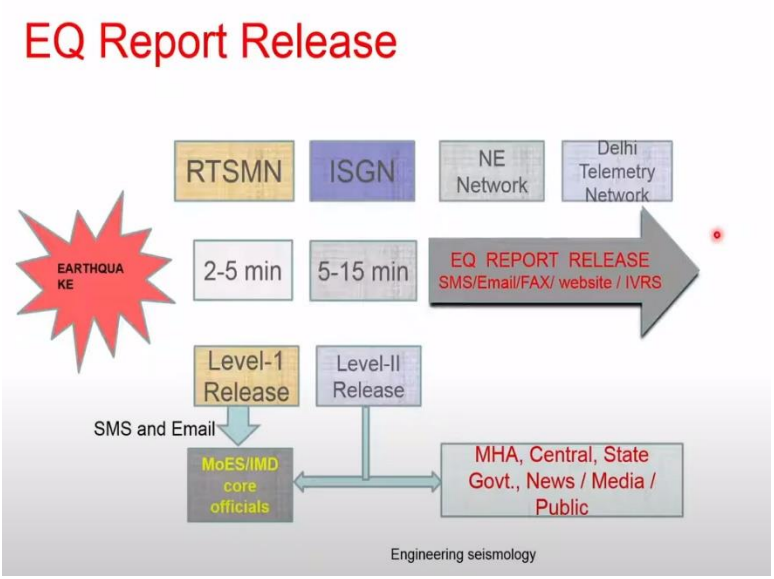

So the earthquake report is released by the IMD officially. So the earthquakes are happen. So this is a different network. So it depends up on the network when they release the RTSMN network 2 to 5 minutes level 1 release IMD MoEs core officials they release. So the level 2 IG ISGN 5 to 15 minutes level 2 release. So then they will also update this one it will release to state government ok so news media public after the 15 minutes.

So then the north east network Delhi earthquake report released by the SMS as soon as the website facts and IVRS depends upon the magnitude and the level of damage expected from this kind of earthquake.

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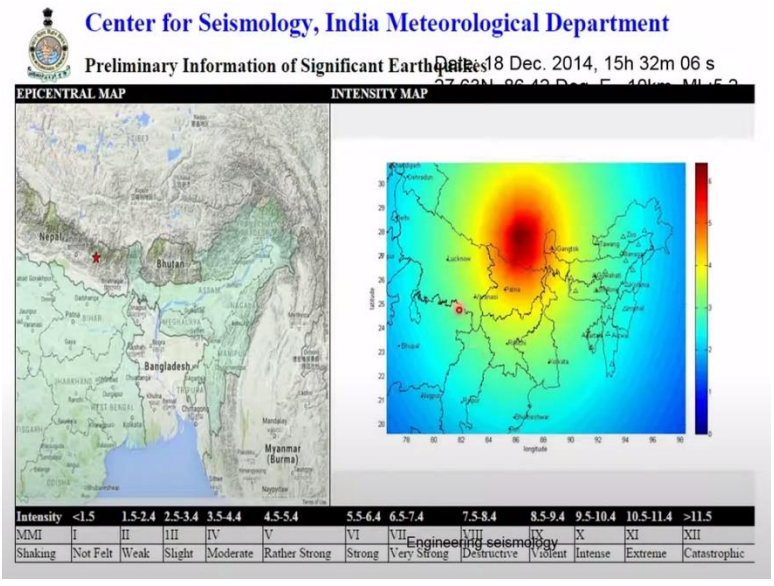

So this is the typically the website where soon after earthquake you can see this is the earthquake. So they also give the intensity scale what is the felt and what was the level of intensity which is reported on this. We will discuss what is the intensity; on later stage. They also release a intensity map which also we are going to discuss in the next class. So the intensity map basically tell you how much damage is expected ok due to that earthquake which is not reported which his estimated for this you need a intensity predictive models ok.

So that model one can use by knowing the magnitude and the distance that will prepare a intensity distribution map at particular earthquake. So, by knowing this so you can show that where red very dark is there so that place you can expect more damage. Wherever there is a light color you can expect a less damage like this. So in general most of the intensity equations so predict that the close to the epicenter location you will have the more damage when compared to the far away from the epicenter location.

It can be noted here that this intensity predictive equation right now India has only one intensity predictive equation developed for India which, we will discuss when we are talking about the hazard analysis and predictive equations required for the hazard analysis ok. So this is how they release this map is called intensity map or the shake map they release soon after the earthquake. So to give a approximate estimation of how much area it is affected ok. So how much the area affected based on that you can guess how the severe earthquake.

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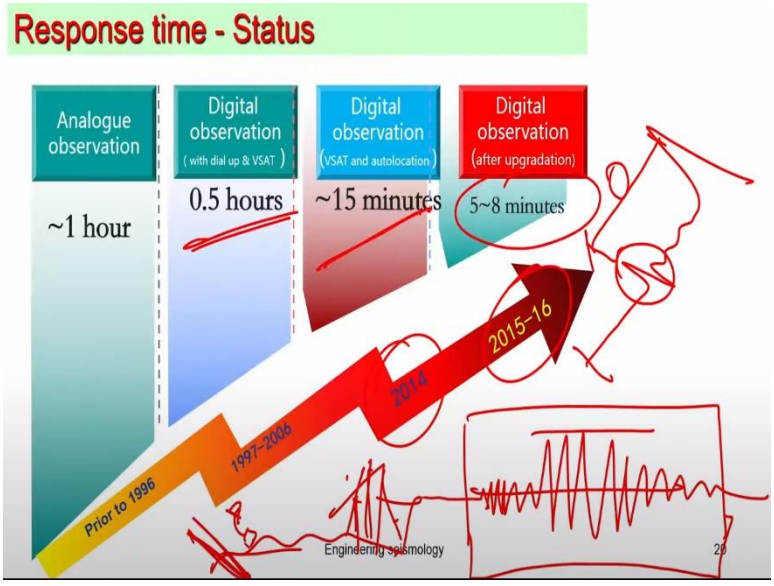

So there is a response time ok so of the each station to the how the data they will get and try to analyze and try to understand when where the earthquake are occurring. For example so, in prior to 1996 so we have most of them are analog observatory. So as we have seen that the analog stations are right a earthquake waveform as a so in the smoked paper or paper using the pen or pencil marking where the earthquake signals are basically written as a wave form ok. So this will be basically draw a waveform.

So basically so the when there is no earthquake it will be moving like this when there is a earthquake so it will draw like this ok. Then like this it will draw so then it will slowly reduce and then go to 0. So then the analog basically they take this data and put it on the trace paper try to measure a amplitude and then try to estimate what is the earthquake magnitude using this. And then that magnitude they report which will roughly takes about a hour to report those kind of earthquake information.

That is why in 19 prior to 1996 you can see the period. So before to 1996 prior to 1996 we can come to know only earthquake after 1 hour. By the time the earthquake may be felt by the wide people around the epicenter and it may not, might have caused whatever damage it has to cause. So there is no does not help of any warning or anything ok. Just to know earthquakes are recorded values we have that is all. So in 1997 to 2006 so we are slightly improved so when the digital system came so where they try to get the information at a within 30 minutes ok half an hour they use to get.

So that followed by so it again so improved further when digital observation VSAT and auto location what we have seen in the satellite based communication and auto location where we could able to get a earthquake information within 15 minutes during 2014 ok. So then this has been now improved so where as on now we can get 5 to 8 minutes about the earthquake magnitude earthquake location precisely earthquake depth.

All those are possible now precisely within 5 to 8 because of the digital observatory as well as this has been communicating with the satellite and storing the data and disseminating very fast those kind of information. So, now the country also working towards ok going forward towards

basically early warning system. Early warning system means so as we have seen that this is the P wave then followed by this is the S wave.

So, in between this time ok so is sufficient to stop some of the important facilities. So basically if you know this one you could guess a magnitude ok then based on that before this arrive this waves come you can shut down some of the facilities particularly underground metro, nuclear power stations all those things to prevent a disaster ok. So this is practiced in Japan where they have very dense seismic network. For example this is the place where the seismic source is there.

Then if you have the seismic instrument here if based on the P wave if you guess what is the; magnitude is going to come. If it is cities located here you can basically release a early warning system and try to shut down automatically the important facilities. For example underground metros or nuclear power station and then the electrical power station and then gas things and all can be closed. Automatic shutdown system can be operated.

So, that the disaster due to the breakage of this is minimized ok. That is how now the early warning system early warning earthquake set up is planned in the country. So hopefully which will happen in the soon in the near future so, we have seen so, how the India basically started seismic network. So we have seen that before Shillong earthquake there is no seismic instrument which was basically 1897.

Before that there is no seismic instrumentation only people who have studied kachakore earthquake in 1869 I think so that time they studied earthquake where the Oldham was prepared a classical report. Then after Shillong earthquake the earthquake instrument has been start installing. So until 1960 we do not have much seismic session. So until 2000 ok we have very less number of station and then many of them are vertical component kind of things.

After 2001 this has been considerably improved. Now the IMD put lot of effort basically to record this data process this data systematically and give to researcher to get a proper output out of this. So which we will basically used basically to develop several things in the earthquake prediction related parameters understanding and estimating and try to get the data. So hopefully in the near future we will also install earthquake early warning network.

So where people can know that the earthquakes are occurring they can try to shutdown whenever possible in between the time period of P and S wave arrival. So that is the well help. So now the things are changing in the country where the time history data is still available to the researcher by a proper channel which has been started very early when I was doing my PhD this was a big challenge.

Now my students are able to get good amount of data. So this will also further improve in the future where we can get lot of regional level so prediction models ok wave propagation theory understanding, getting the wave propagation prediction properly. As I told you that intensity shake map or intensity maps are not good at this level in the county we are using some intensity map which is not appropriate kind of things.

But still that is a as of now knowledge and status so which will be improved in the future. So now so we have seen the wave propagation how the waves getting recorded like P wave S wave which is seismometer record where the shadow zone ok. So which are the waves which can expect, so then how these waves are we are measuring seismometer? What types of seismometer? What are it is capacity? And then in the country what are the seismic station development we have seen.

So in the next class we are going to talk about if you have the recorded seismic station with data from particular station with you how you can estimate or quantify a earthquake. How to scale or how to quantify a earthquake we are going to see in the next classes. So with this I close this class thank you for watching this video. So if you have any doubts so please get back to us weekly session in the TA's with TA as well as with me and also write to me ok so that we will try to clarify as much as possible. Try to make you understand what is this subject? I will help, you so thank you.