Introduction to Engineering Seismology
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Lecture - 02
Earthquake Hazard Mitigation and Preparedness

So vanakkam. So today we are going to talk about the preparedness for the natural hazard, how to reduce human loss as well as the economical loss. So since last class we have talked about the what is meant by the natural hazard and then how the different continent experiencing the number of natural hazard and then how the economical loss and then how the human loss we have discussed.

So and finally, we understand from the past earthquake history that the poor and the developing countries are experiencing the number of people death is twice or larger than the developed or rich countries for the same magnitude of the natural event. At the same time, the developing countries and poor countries experiencing the half of the economical loss when compared to the developed or rich countries for the same level of natural hazard.

So if we want to reduce this natural hazard, so there are two way we can reduce.

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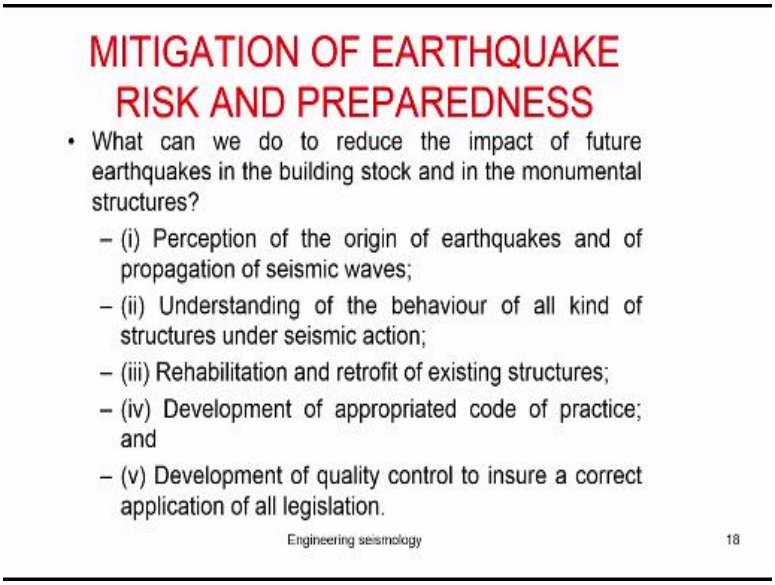

One is that predict that particular natural hazard and then try to escape from that by means of some kind of preventive steps okay. So or you can have the planning, such

that you will even if it is not possible to predict a natural event, you can still minimize this one. So far we have seen that the flood can be predicted, so where you can minimize the human losses.

At the same time earthquake cannot be prevented. So if this kind of so natural hazard which is not possible to prevent predict by earthquake volcanoes, okay. So dry mass movement and all. So how to reduce that okay? How to mitigate a risk from the by our preparedness. So what you do? So there are some way of approach.

We can adopt this kind of approach and then prepared ourselves even this unpredictable earthquake occurs at any time you can escape or you can reduce the risk and human loss due to this kind of hazards. So one is that the perception of origin of the earthquake and its propagation of the seismic waves. So as I told you that we will be discussing throughout our class geophysical hazard.

Among the geophysical hazard the earthquake is the large number of events occurring and causing a economical and as well as human loss. So our focus would be how to reduce or mitigate a earthquake risk. So one is that the first step is the perception of the origin of the earthquake and propagation of the seismic waves. So what it means? The perception means basically, we should have idea about what is meant by earthquake, okay.

When earthquake occurs how the seismic waves travels? So this kind of perception should be there. So I will give you the example. So the perception is actually what is happening in the region we should know rather than having our own perception without understanding where we are sitting. So if we look at peninsular India or southern India, so many people believe that the peninsular India or southern India, there may not be any earthquake.

There may not be any earthquake so we no need to design our structures towards this earthquake. So this kind of wrong perception without even knowing what is the seismic status of peninsular India or how many earthquakes are occurring. So where and all it occurs? Where is the seismic source, nothing but we have the perception. It is because our forefathers are not experienced those kind of things.

So with knowledge transfer or poor knowledge transfer because we only refer our father as a forefathers, not the father and his grandfather and grand grandfather we do not refer. So that kind of wrong perception also give you a problem. So in that case, we should be basically making a proper perception based on the our experience.

For example, during 2000 before 2004 or during the 2004 if somebody says that there may be a tsunami going to come in eastern coast and it will affect the people, people will laugh at because many of us does not even know what is meant by tsunami before 2004, okay. Even including the highly educated people with doctorate qualification or the qualification of highest degree even they may not be knowing what is meant by the tsunami before 2004, okay.

Why because there was about more than 300, 400 years there is no such kind of tsunami has occurred in this region. So people have the perception that there is no such kind of tsunami is happening which is actually a wrong perception. So why because we have the less knowledge of history, okay. So if you look at very carefully the history back okay for 1000 years and then the 2000 years or 5000 years, you see on the same region, then your perception, you will understand that it is wrong, okay.

So the many of you may be knowing that whenever you visited a Mahabalipuram place okay, which is very close to the historic town close to the Chennai okay, this place called you might have seen that there was a some stone structures, which is in the sea. So do you think that somebody gone and built this stone structures in the sea? No. So this was once that stone structure place was a land.

So there was a tsunami, which has occurred about 800 years or back, okay. That tsunami basically suck this land to the sea. So that is why that stone structure in the sea, the same stone structure you can see in the land also. That means it is a big town, part of the town consumed by the tsunami. If people remember that history, if somebody says tsunami going to occur, they may not laugh, but that is what happened.

So 2004 after tsunami only people realized that so there is a tsunami which going to occur or it is occurred in this region which is frequently may not occur, but the time duration is roughly more than 500 years or 800 years return period. So then people have did actually the Paleoseismology study. We will discuss paleoseismology study in little later.

So that paleoseismology study is basically study which actually they make some kind of excavation in the earth and then the carbon date a different layer deposit in the earth. And based on that, they say that, when was the last earthquakes are occurring, seismology events are occurred. That kind of studies are the paleoseismology study.

People who are done after 2004 tsunami they carbon dated and they found that there was a two big such earthquakes are occurred in the region and caused tsunami and many people died in those days. So if you go back to the history properly, okay, so if you look at the history there is a city called Poompuhar okay.

So which was once was there in the eastern coast, which was consumed by the sea that is called as a kadalkol in Tamil language. The kadalkol means basically a tsunami, which is very frequent in the Japan, but less frequent in the Indian region. That is why we do not have history. So that kind of preparedness or perception means we should have the origin completely and have the clear idea of perception rather than a wrong perception.

So here I also like to share that in my class I was asking the each one sitting in the class, okay, so where I teach Master and PhD student engineering seismology, so I was asking them with respect to their hometown, where is your hometown? So what do you think? And then, so do you expect earthquake in your region? So there was a one interesting case. So that particular student said that we are living next to the temple.

So we do not expect any earthquake in that region. So such kind of wrong perception after getting the degree and education, such kind of wrong perception will lead to a disaster. So the people should have the correct perception and origin of the earthquake depends upon the geology and seismotectonic in the region.

So once you know about there is a possibility or not possibility the next is if that is possible, how the wave seismic waves are propagate in your region. That knowledge is very important to mitigate the earthquake risk in the particular place. The second is understanding behavior of all kind of structure under seismic action.

So whatever structural practice you do in your region, you should understand that how this particular structure behave when earthquakes are occurring. So that he will help us that the structure which is behave badly should be should not be constructed or should improve to perform or behave during this earthquake events safely, okay. That is the second part. Third is rehabilitation and retrofitting of existing structure.

So many of the structures they do not follow a earthquake design. So in case if you know that this is a earthquake risk going to come at that particular place, you should have the proper rehabilitation retrofitting scheme which will reduce basically a earthquake risk if earthquakes are occurring. The fourth is development of appropriate code of practice okay.

So that means you develop a code and tell people that you design for this particular seismic force. So if you say that if you design for that you will not at earthquake risk. So the people also should follow that and then follow. So the one is that providing the design value also will reduce a risk. So people will use that and design.

The fifth one is whatever we give design codes how people will practice that quality control okay and then all correct application of the whatever the legal procedures or formalities, we recommend to reduce this kind of earthquake risk. So these are all the way we can mitigate. So what is that? One is that to try to understand how the earthquakes or origin, how the perception about the earthquake.

Second is how this earthquake seismic waves will propagate. How the structure will respond okay for this kind of seismic wave comes. So if the bad structures how to it can be rehabilitated and retrofitted. And then give a appropriate code for the all the future new design and also quality control those things.

All these five steps can help you to minimize or mitigate the earthquake risk. So this can be taken at two level. One is that institutional level.

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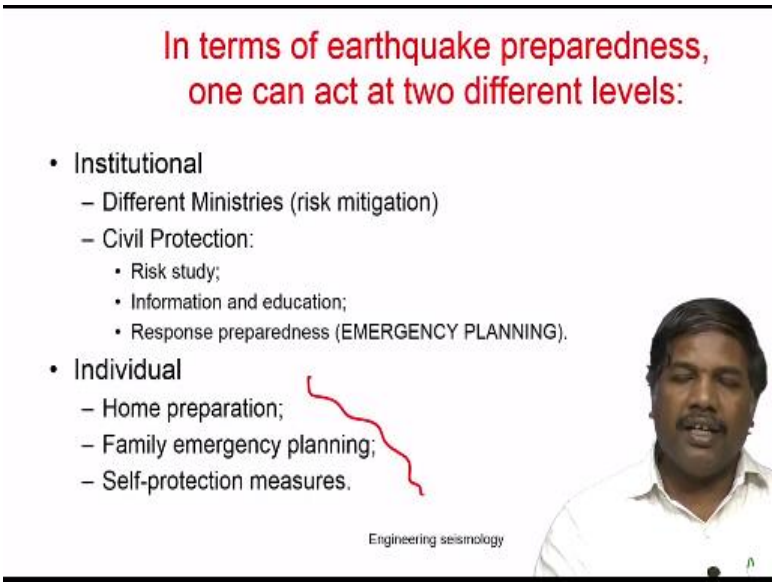

The another one is the individual level. So what is the institutional level? Institutional level is level which where the government plays a major role. For example, different ministry. So different ministry should prepare a their plan of action to reduce seismic risk at their level. So maybe you will be very familiar with that.

Now the government, each state and central government, they are monitoring the number of COVID cases and then how many people die and how many people basically relieved from disease after the quarantine period or after treatment. So this kind of institutional management is the institutional level definition where people ministry will do their duty properly on this earthquake hazard and try to minimize the risk.

So which includes like risk study okay, information and education to the people and response preparedness like people make a allot and prepare a emergency planning okay. Those kind of steps will in the institutional level preparedness. So individual preparedness, each one of us or each one of living in the particular area or particular region should have a home preparedness.

Everybody should know what is meant by earthquake. If earthquake comes what I should do okay. Then a family emergency planning. If earthquake comes where we

should go and exit or where we should go and hide. That kind of knowledge should be is planning. And then self-production measures. So the self-protection measurements you might have seen in the flight okay.

So whenever you fly the any airline, so they give say that whenever there is a the depression within the flight due to any unusual scenario. So there will be a oxygen mask falling. So they say that first you protect taking oxygen mask to you then you protect the people around you. So that means a self-protection. So whenever earthquake occurs, what you should do and then later what the others in the family should do and or you should guide them to do.

So that is the self-protection measures. So as per my knowledge, so most of the Asian countries people having very less knowledge on these things. So even I can say that in the most of the you people who are in the class how many of you know what to do when earthquakes are occurring? How many of you know that how to behave when earthquakes are occurring?

So for example, the earthquakes are occurring okay, you are staying in the 10th floor. You have one person staying in the ground floor. So if earthquakes are occur you can have to escape okay. So this two scenario is not same. The person in the ground floor can try to escape, okay if it is very close to the exit. If it is not very close to the exit if he try to escape, by that time the building will collapse and fall on him, he will die.

If he stand on the same place sometime he may be escape. That building may collapse and fall on some other direction. At the same way the same kind of escaping tendency is with person who are staying the 10th floor, he will try to escape through window so rather than going and hiding. So this kind of the misunderstanding as misbehavior during the natural disaster very common in the developing countries people, particularly people in India.

You may be knowing that there was a person who during the fire, okay in the one of the coaching center during the fire, he tried to jump out of the that center and died, but that fire was not so big, many people in that place says. So like that, we should know

what to do when such kind of earthquake or any natural disaster occurs. That is like a individual preparedness.

So with this, I tell you all of you first to learn, go to the Internet, and search what I should do when earthquakes are occurring. How I can prevent myself to getting injuries or loss of life due to earthquake. What are the steps I should follow? There is a standard web streamlined steps are there which you need to follow.

So one of them is that so if you are in the place where you cannot easily come out very quickly the best way is go and hide to the somewhere below the table or hard surface okay so that even the roof or anything falls which will not hurt your head okay. Because the head is the prime control of the entire body. So if the head is saved rest of the body even if you have the injuries or damage you can survive.

So like that there is a step of streamlined criteria given to the common public people even NDMA website you can refer. So which you have to prepare and should aware about the same.

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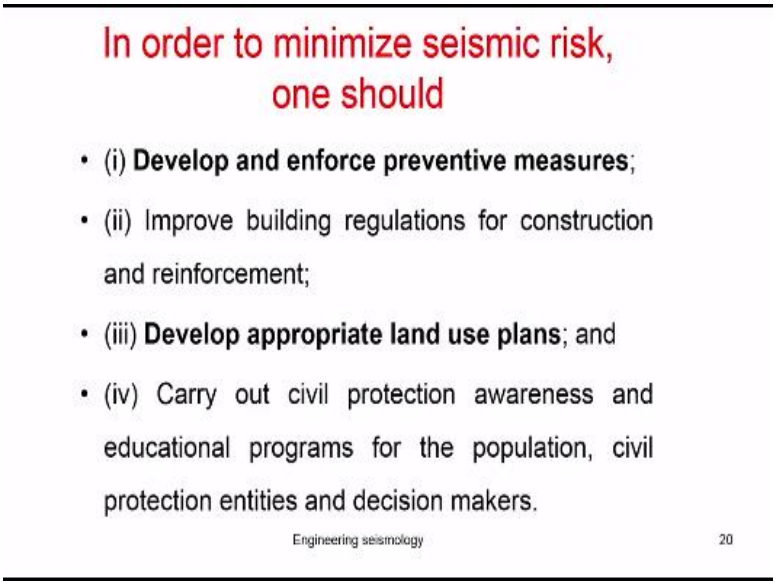

So in order to minimize this kind of seismic risk okay, one should do that develop and enforce preventive measures. So okay so we should develop and see that developed enforcement measures are improved. And improve the building regulations because most of the people die due to the earthquake because of the damage of the building, not due to the directly a earthquake okay.

Then develop appropriate land use plan. So the develop appropriate land use plan is for example, if your one entire region they do a seismic risk assessment and found that there are places where there is a high risk. So in those kind of high risk, the important facilities should not be kept. For example, the Secretariat office, police office, hospital. So these are all the emergency facilities where this has to work anytime.

So if you keep the important facilities there, there is a chances that this get damaged and the people may not get required assistance during the disaster. So that kind of the land use planning. And then keeping a nuclear power plant and then chemical industry which are all may not directly earthquake may cause a damage or human loss, but the breakage or damage of this kind of industries will may cause a harm to human or risk to the human.

So these kind of places should not be kept. That is called a development of appropriate land use plan. So which facility where to keep. And carry out a civil production awareness like to do a drilling. When earthquake comes how people should go, where to move, how to behave. So those kind of educational program and then a civil protection entities and decision makers. So that kind of training will help.

So there are some states okay in India where people basically do a mock drilling what to do when earthquake comes. So that is only occurs at few places and not throughout the country. Many of the people in India does not know what to do when earthquakes are occurring. So that is a very sad part but at least the people who are taking this course so now you should go and study what to do when earthquakes are comes.

How you can individually you can prepare yourself. How the institutional level preparation you can do okay. So with this basically we close the earthquake hazard and preparedness class. So in this class basically we discussed so what is meant by the natural hazard and man-made hazard, okay. How the hazard become a disastrous, okay. So then how this disastrous distributed on different continent.

So we have seen that the Asia is the around 50% of the geophysical hazards are occurring, but the damage due to human loss due to this hazards are 100% even though the number of events are 50%. So similarly because of the education and economical status, so we are exposed to the very high level of risk because of our lack of preparedness okay. So that we have seen.

And then we have seen that the poor countries are basically affected more okay for this kind of hazard when compared to the developed and rich countries for the similar kind of natural events, okay. So and also we have seen that individually or institutional preparedness what we should do? So how we should do.

So all of you what you should do basically you should go to the website and browse what I should do when earthquake comes? Do I prepared for that? What are the steps I should follow to escape myself and also advise my family. That is what you should do. So the institutional level preparedness is basically so like us okay, so where the government and then the dissipation of knowledge, what is meant by earthquake, how it comes, okay.

So what are the things will happen when earthquake comes and educate a people is the institution level. So the NPTEL course basically this course is one of them, where we try to educate all the people who are taking this course on seismic events okay. So we will try to see that how different hazards are caused from the seismic events. What are the those hazard and try to see how the seismic events is basically measured.

How it is occur? What is the scientific background and what is the physics behind occurring of earthquake okay. So then how you can measure this, how you can quantify this, how you can understand the wave propagation and how you can prepare okay or assess the seismic risk at a particular location. So up to that we will be discussing in this course, okay. So you may be ask why I should estimate risk myself?

So most of you may be knowing, the people who are studied civil engineering, B.Tech may be well knowing this. So in our country, there is a code called seismic code okay, which says the entire country is divided as a different zone and they are

given some value to that particular zone, which is generally used for the design of buildings.

So as per my research and work carried out so far in this area, okay, I can say that the values given in the seismic code is not appropriate okay, which I found during my PhD when I was doing PhD on seismic microzonation in Bangalore, which has been highlighted to the ministry and then I come up with the concept of microzonation.

Microzonation means, based on the different possible seismic hazards at particular location you prepare a zonation map and highlight which zone having what value. So based on that people will prepare themself to design a new structure or retrofit the old structure and also know about the earthquake. So currently our seismic code is not giving the hazard for the future, which is only based on the past earthquake the mapped hazard, which is not appropriate.

So at the end of the course, you will be understanding why I am talking this. So our course basically will emphasize how you can prepare most reliable seismic estimation at a particular location okay. So the course is contented and also prepared such that if you have the basic science and math knowledge like plus two qualification, you can follow this course basically, okay.

So you no need to have any degree. So that qualification is there. So sometime there may be slightly we go on the upper side of the course. So where if you do not get any clarification, if you do not understand properly please get back to me or my TS. Sometime we will be teaching very basic. So the people who have studied M.Tech or B.Tech, they may be feel that very small, but you should know that this course was kind for the people who graduate a plus two degree.

So by assuming that you have to basically balance both of them. So if you are well understood, it is always good. If you do not understood you please get back to us, we will try to clarify that. So with this we will finish our second lecture. So the next lecture we are going to talk about what are the different seismic hazard can occur at a particular region if earthquakes are occurring.

So I talked about the different type of natural hazard. So among the natural hazard, geophysical is the one of the hazard. Among the geophysical, earthquake is the another hazard okay. So in the earthquake, the earthquake itself has a different type of hazards. Or earthquake itself causes a different type of natural hazard, okay.

So which is called as a seismic hazards, okay. So different type of seismic hazard which we will be going to discuss in the next class, okay. So this lecture is actually compiled from the past earthquake damages and histories, what are the hazards can cause by the earthquake, okay. That we will be discussing in the next class. So we will close the class now.