NPTEL

NPTEL ONLINE COURSE

Structural Dynamics
Week 12: Module 02

Vibration Control
Ramancharla Pradeep Kumar
Earthquake Engineering Research Centre
IIT Hyderabad

welcome to structural dynamics class so in this class we will study vibration control so what is vibration control quite often it happens that because of the external forces say such as earthquake or wind or sometimes machines which are installed on the structure are inside the structure vibration amplitude may go may become very large so that will cause a potential thread to the structure itself that is number one and the second money it may cause inconvenience to people.

So for that we need to take say comfort into account and then safety into account for that reason we need to control the vibration f structures so as a philosophy what is this vibration control so let me explain you in a simple terms for example so you are travelling in a bus so when you are travelling in a verse then you are standing so when you are standing bus driver suddenly starts the bus so what will happen if you just stand and bus driver is starting the bus so you will fall backwards.

So will fall something like you will fall backwards so why it is happening it is happening because you are at rest and bus driver has suddenly started the bus so you are at the that is called inertia of rest so it takes a moment for you to realize and stand correct so that you are standing in a moving bus so this is say case 1 so will become unbalanced and that may fall back then next one is say we are in a moving bus you are standing and suddenly bus driver applies break so what happens in that case we will fall forward.

So that is inertia of motion so we are trying to move because of the motion of the bus we are in motion and suddenly when bus stops then will fall backward so what usually happens so will falling backward or when we are falling forward will try to take a support now let us take say a

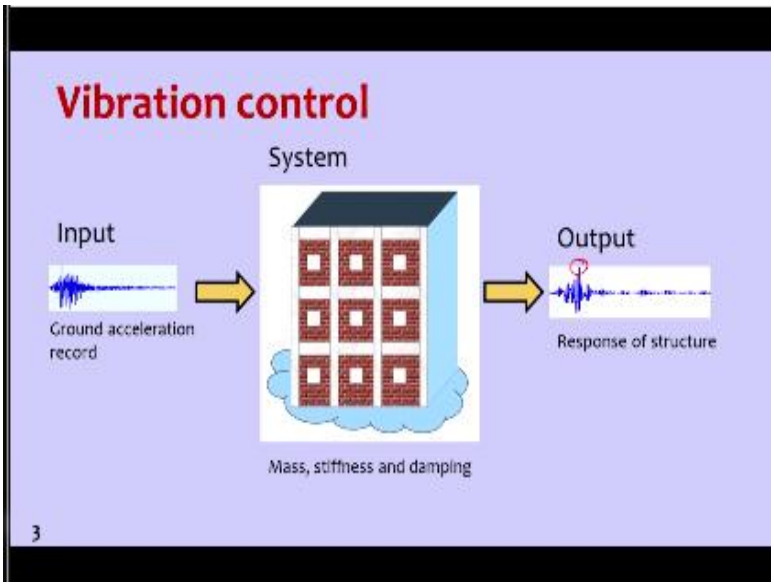
third scenario in a third scenario you are standing and bus is moving so you are standing in a moving bus and so you are holding the hanging not the handrail but some hanging that is a ring you are holding .

So then when bus driver applies break what happens is so your neurons under the feet will sense that and immediately they will send signals to your brain that you will fall forward so you will immediately hold the ring so in this case what happens is you not fall forward and your displacement is largely reduced but still you will move forward that is say case 3 and in case 4 what happens is say instead of holding the ring if you are holding the rod itself you are holding the rod itself then what happens is that your displacement even when the bus driver applies break your displacement is almost completely restricted.

So I have explained you four cases so first one is inertia of rest so you will fall backward that is inertia of rest second case inertia of motion so will fall forward so here you are not holding anything so you will fall backward in inertia of rest will fall forward in the inertia of motion third one is you are holding say a ring when you are holding ring your displacement is restricted by and large but still you are displacing so that is called passive damning that is called passive damning so in passive damning will reduce the amplitude of vibration but not completely now the fourth one where your hood directly holding handrail so what happens is depending on the displacement required also restriction of the displacement.

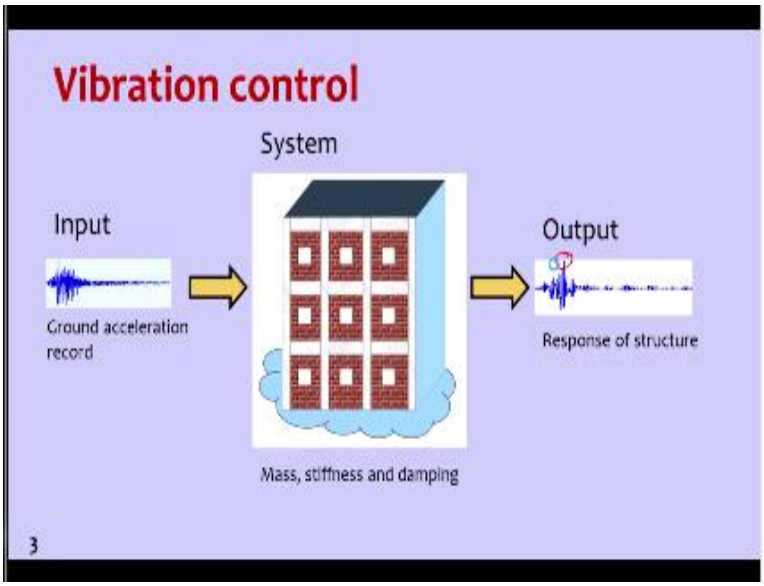
We will press it very hard such that the stiffness of our system increases so this is world active damning so inactive damning we are adding some elements which are increasing the stiffness of the structure but in passive damning we are not doing that so in passive damning we are defined trying to defy the system so and then in active damning we are trying to comply with the system so these are done things now let's go and see how it works.

(Refer Slide Time: 05:05)



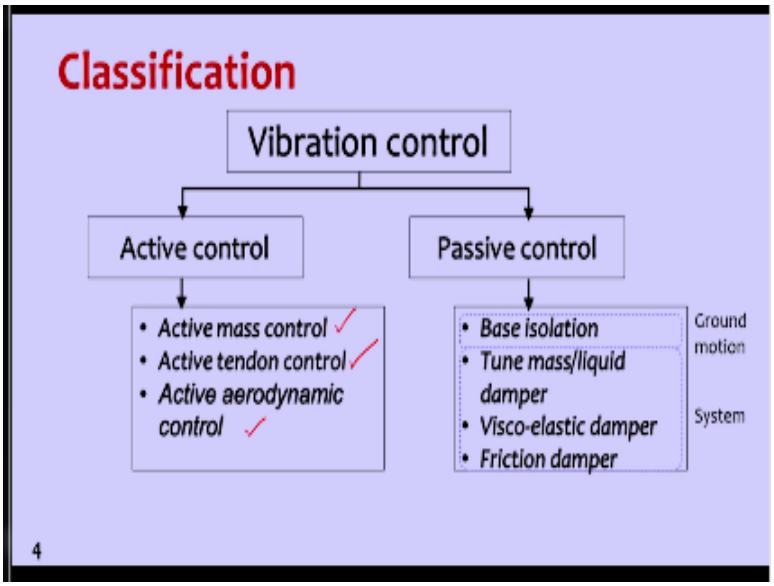
So if you look at this picture so this is input ground motion so it is in putted to the structure which has mass stiffness and damning and this is output so what we are worried it is we are worried about this amplitude art so if amplitude is very large then it is not good for the safety and sometimes comfort of the occupants so we need to restrict the vibration.

(Refer Slide Time: 05:31)



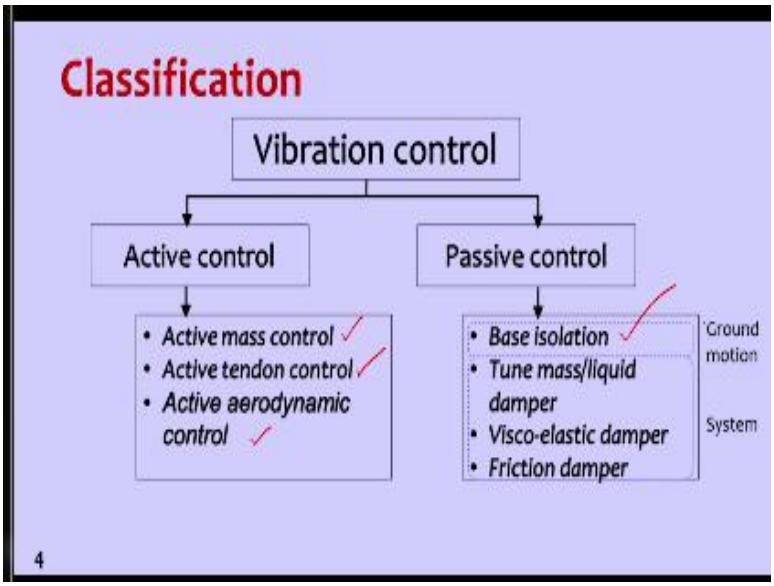
So vibration control is classified into two major arts.

(Refer Slide Time: 05:39)



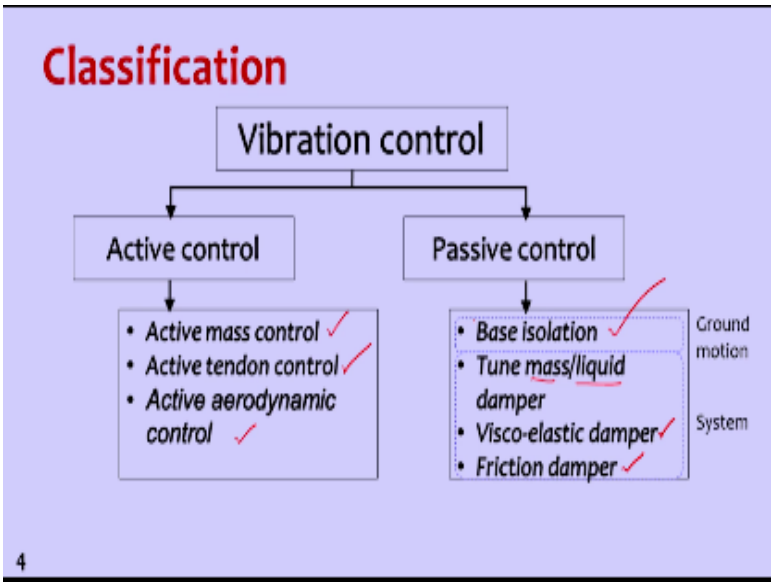
One is active control second one is passive control so in active control we have active mass control active tendon control so this is usually in bridges and then active aerodynamic control okay so this is this again happens in long san bridges cable-stayed bridges and then towers the communication towers cables is it have this active aerodynamic control .

(Refer Slide Time: 06:03)



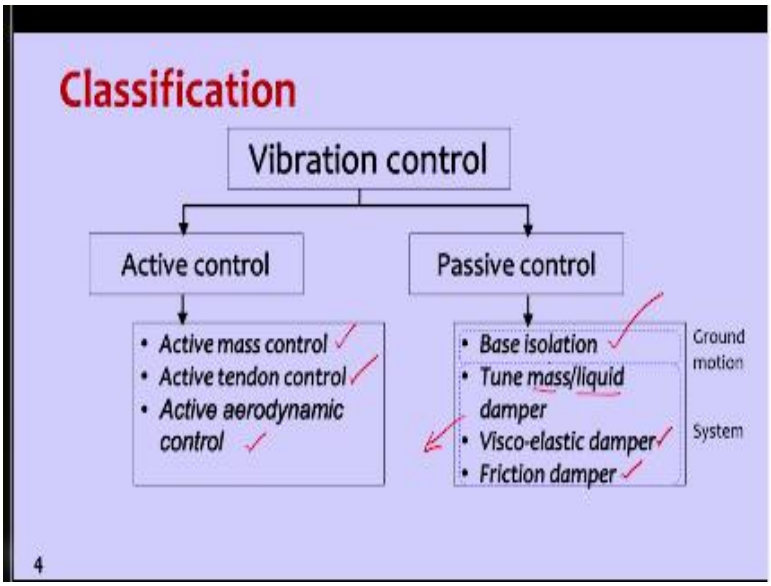
When it comes to passive control we have say two major ways of doing passive control so one passive control method is called base isolation so in base isolation what we do is we will not allow the ground motion adverse arts of the ground motion to enter the building so that is we are isolating that is base isolation.

(Refer Slide Time: 06:25)



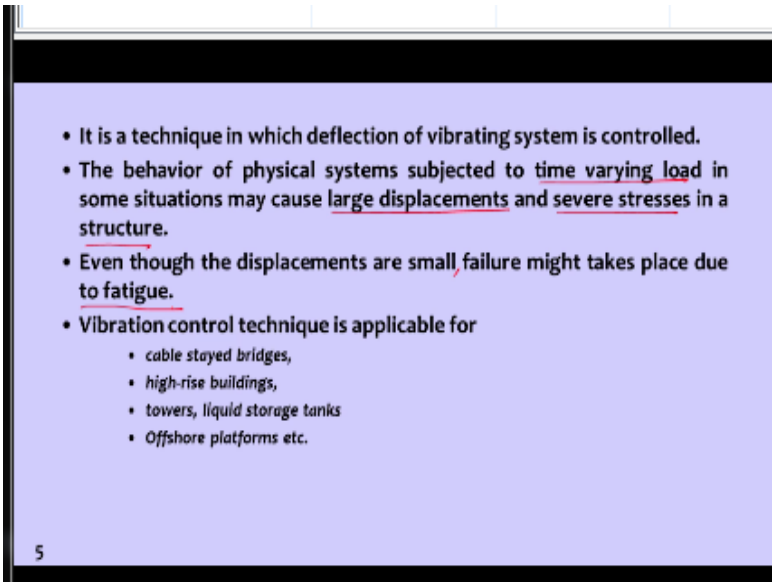
In the second one is when it enters the building so how do we control so we can control by tuning mass are tuning liquid damper so because little soon mass damper tuned liquid damper and there is another system called visco- elastic dampers and then another system called friction damper so all these commander passive control here we are taking energy into the system and we are dissipating it outside through the system.

(Refer Slide Time: 06:52)



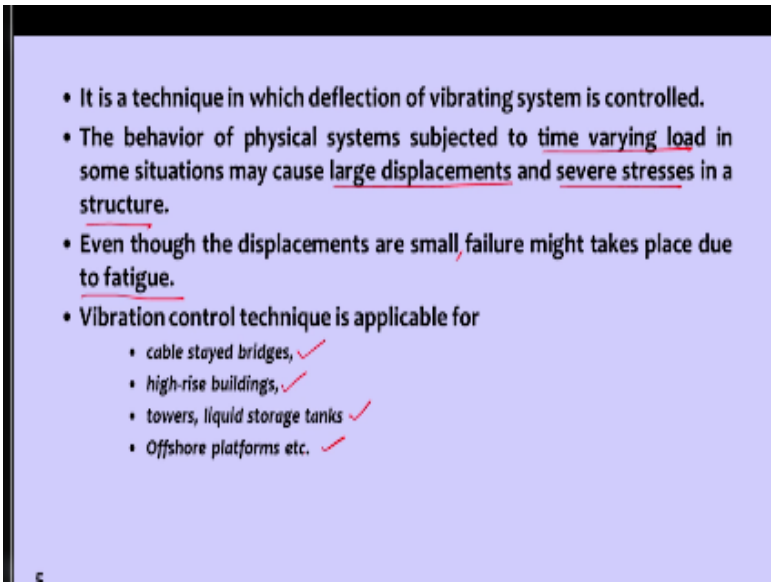
But here what is happening in base isolation we are not allowing energy to enter into the system so that is isolation so these two come under passive control.

(Refer Slide Time: 07:05)



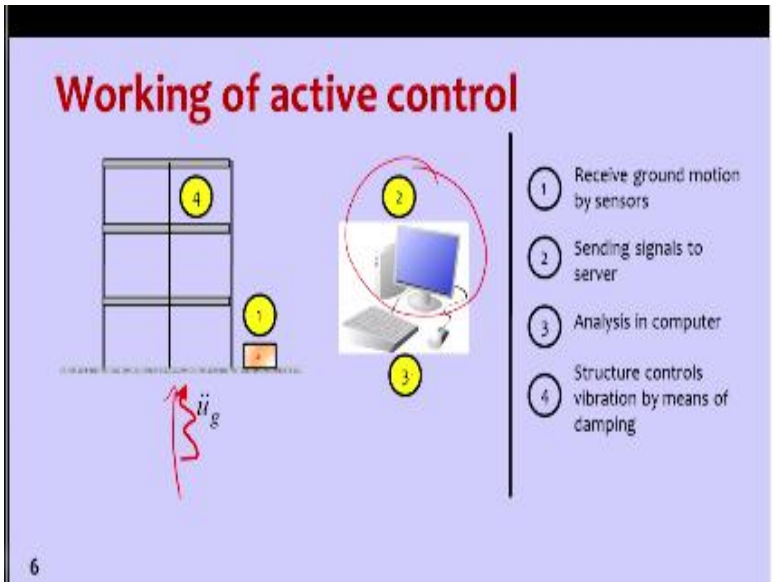
So this control is a technique in which deflection of vibrating system is controlled so the behavior of physical systems subjected to time varying load in some situations may cause large displacements and severe stresses in a structure even though the displacements are small failure might take lace due to fatigue so this fatigue is another phenomena where small force acting for long time it may cause severe deformations in the structure.

(Refer Slide Time: 07:39)



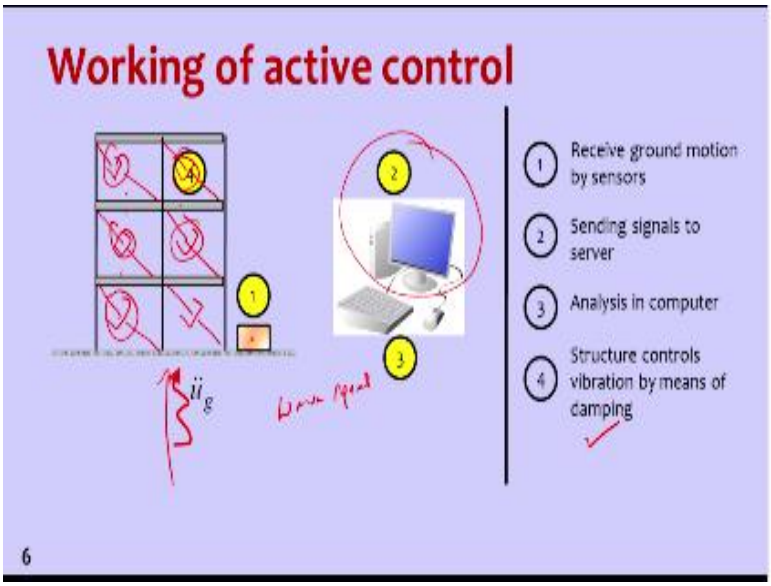
So this vibration control technique is applicable for cable straight bitch high-rise buildings towers liquid storage, tank, offshore platforms and many other buildings.

(Refer Slide Time: 07:52)



So now let us discuss about active control of vibration so inactive control of vibration what happens is when say ground motion is entering trying to enter the building then we place a sensor on the ground itself we place sensor on the ground itself and receive ground motion in that and then we send that ground motion to model .

(Refer Slide Time: 08:59)



The structure using this ground motion and find the response in a system and then the kind of displacements forces which are acting on the system we will give feed to different arts and then control this vibration using say supplemental damping so that it's additional damping we make use of that so these additional damping will come into picture only when there is instruction using the signal otherwise they are inactive so this uses the speed of the wave so wave speed is crucial in this one so the moment me since the acceleration pulse .

So we send that information and model the structure and control the dampers here so this is called active damping so that is receive ground motion by sensors sending signals to server analyze in computer and then structure controls vibration by means of damping so this is active damping system usually there is a belief that this vibration control is used in many ,many buildings in advanced countries so it is not true very selective buildings in few countries are under active control in there are quite a good number of buildings who are employing which are employing passive control techniques so we will discuss passive control techniques in the next class.

IIT Madras Production

Funded by
Department of Higher Education
Ministry of Human Resource Development
Government of India

www.nptel.ac.in