Structural Health Monitoring (SHM)
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Lecture - 19
Part - 1: Local and Global Health Monitoring

Friends, let us welcome to the 2nd lecture in module 2.

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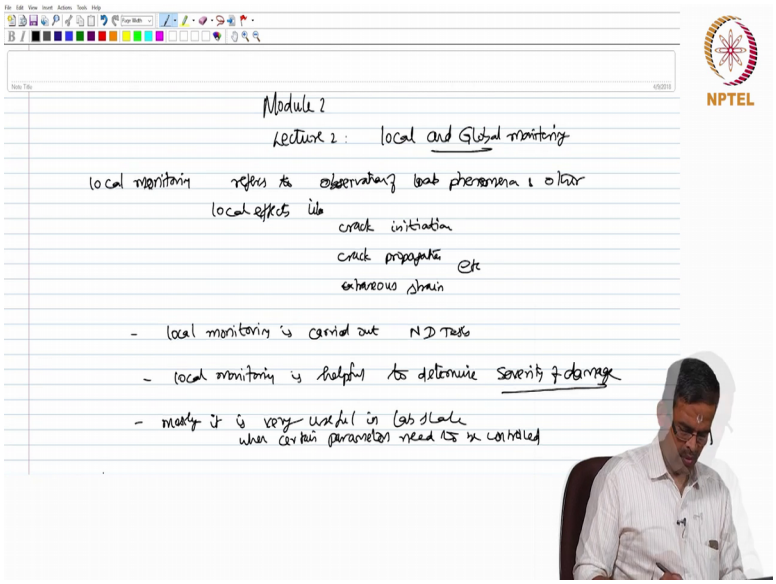

In this lecture, we will focus on Local and Global monitoring. Local monitoring refers to observation of load phenomena and other local effects like crack initiation, crack propagation, extraneous strain etcetera.

Generally, local monitoring is carried out using Non Destructive Tests. Local monitoring is helpful in many ways; specifically, it is helpful in determine the severity of damage.

Mostly it is useful in lab scale when certain parameters need to be controlled. For example, you are modeling a girder of deck of the bridge.

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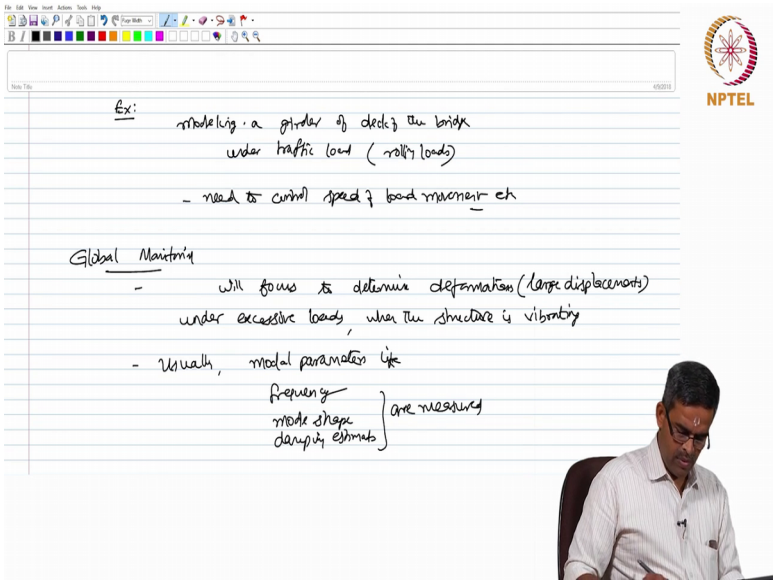

Let us say under traffic load which will be essentially influence of rolling loads on the deck and you need to control the speed of the vehicle etcetera in the lab scale. Global monitoring will focus to determine deformations, let us say large displacements under excessive loads when the structure is vibrating.

Usually, modal parameters like frequency, mode shape and damping estimates are measured.

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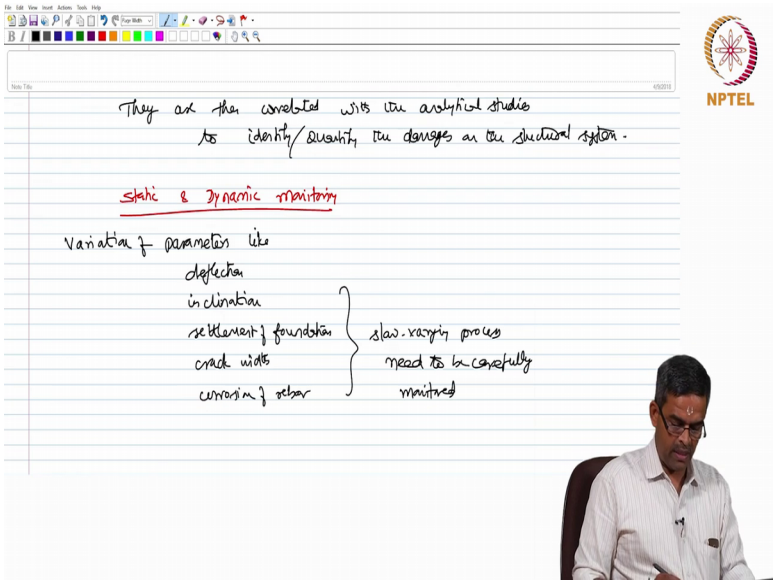

They are then correlated with the analytical studies to identify or I should say quantify the damages on the system.

Friends, the next category will be the Static and Dynamic monitoring variation of parameters like deflection, inclination which can be an important parameter in case of bridge piers, settlement of foundation, crack width, corrosion of rebar which are essentially slow varying process; need to be carefully monitored. Sometimes their effects cannot be monitor under static loads.

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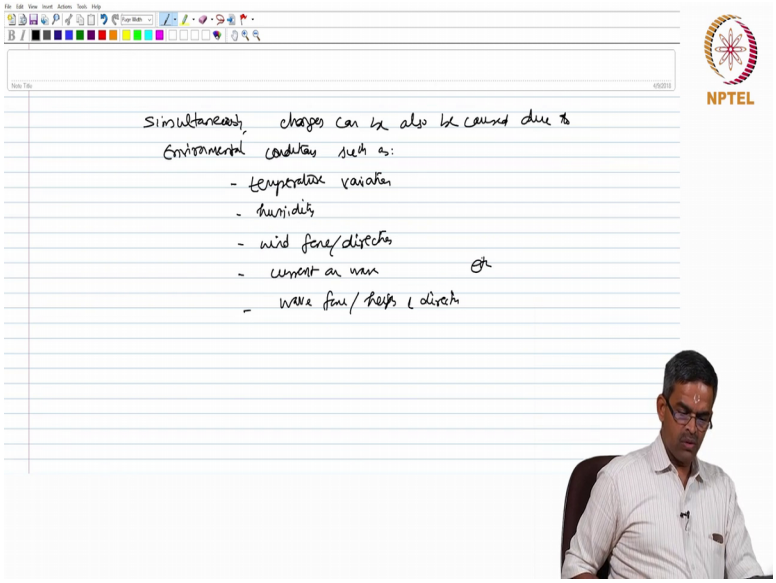

Parallelly or simultaneously changes can also be caused due to environmental conditions such as temperature variations, humidity conditions, wind force and wind direction, presence of current on wave, wave force or wave height and direction etcetera.

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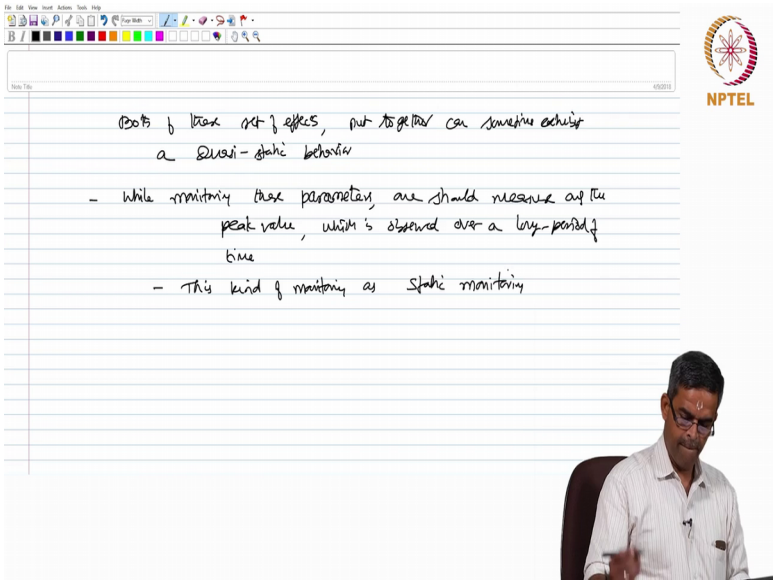

So, both of them put together, both of these set of effects put together can sometimes exhibit a Quasi static behavior. This is neither purely dynamic nor completely static.

Therefore, while monitoring these parameters, one should measure only the peak value which is observed over a long period of time. We call this kind of monitoring as static monitoring.

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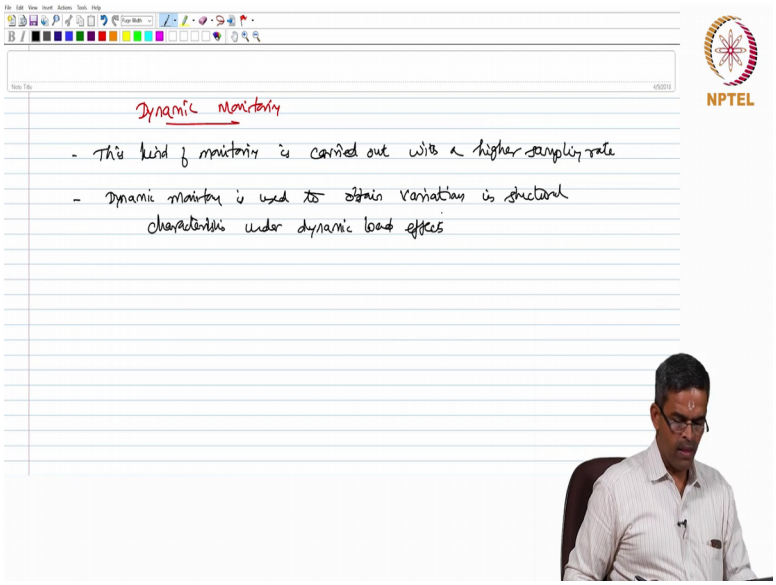

Then, what is dynamic monitoring? This kind of monitoring is done with the higher sampling rate.

Dynamic monitoring is used to obtain variations in structural properties and characteristics under dynamic loads or I should say dynamic load effects. Now let us have a comprehensive look of different kinds of sensors and different kinds of monitoring from this table.

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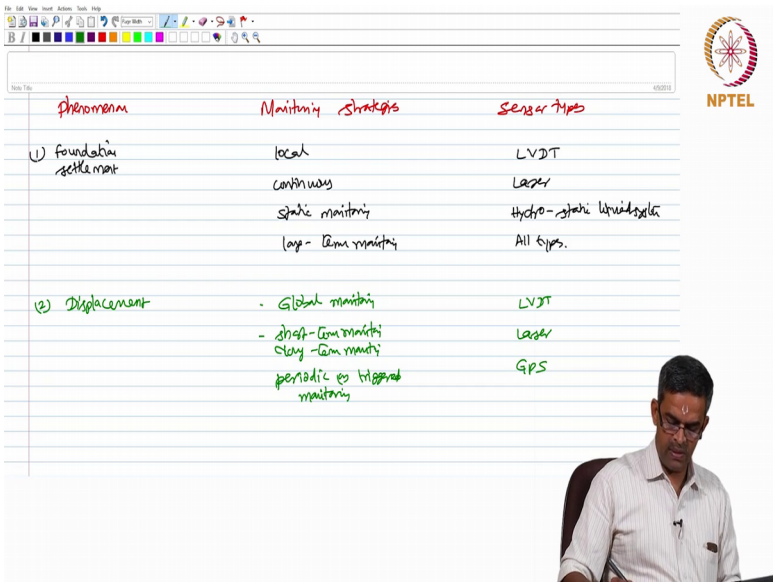

Let us talk about the phenomena, the Monitoring strategies and the sensor type which can be used for a specific kind of monitoring.

Let us say I am interested in monitoring the foundation settlement. It can be monitor locally. It can also have a continuous monitoring system. It can have a static monitoring condition. One can also plan for a long term monitoring in case of foundation settlement.

The sensor types which are generally recommend will be linear voltage differential transformer. One can also use non contact type Lasers. One can also use Hydro-static liquid system and other types all of them combined can also be used.

If you want to monitor displacement or deformation, then I can also do this has a global monitoring; can also be a short-term monitoring and a long-term monitoring. One can also do a periodic monitoring or a triggered monitoring depending upon the condition to measure displacement. So, the sensors use could be LVDT, non-contact type laser and one can also use GPS active sensors.

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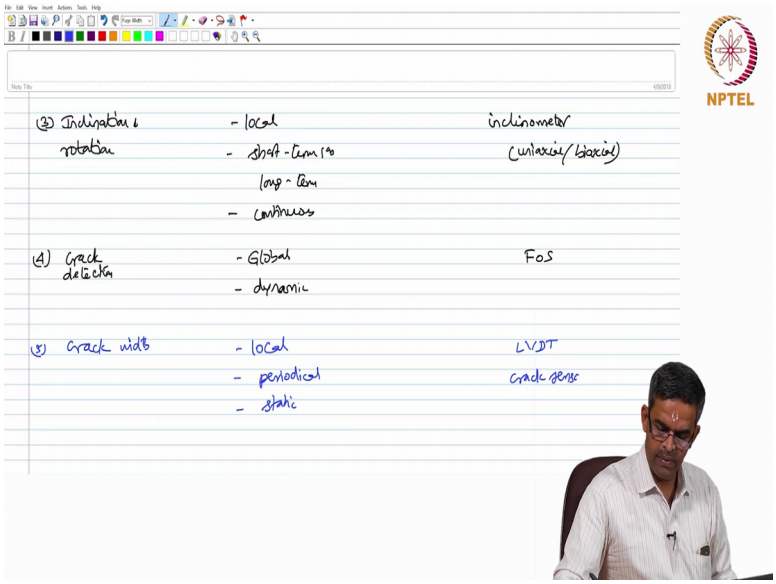

If you want to measure inclination and rotation, I can monitor this under local short-term or long-term monitoring can also sometimes recommend or continuous monitoring to measure the inclination because it is a slow varying process.

So, here the sensor used is inclinometer. It can be uniaxial; it can be biaxial. One can parallelly measure the inclination (Refer Time: 12:47) is this put to both the axis on plane.

Fourth type of measurement could be crack detection. It can be a global monitoring phenomena. It can be a dynamic monitoring phenomena. Generally, Fiber Optic Senses are very successful in measuring crack detection. The next could be crack width. This can be again a local phenomena.

It can be a periodically monitored phenomena. It can be again a static monitoring phenomena. People use LVDT and crack senses to measure crack width.

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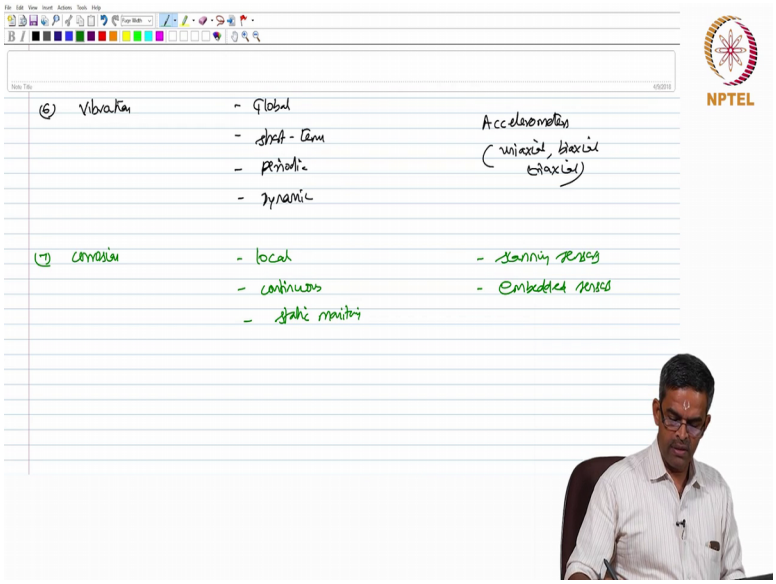

If you want to measure vibration which can be a global monitoring, which can be a short-term monitoring or a periodic monitoring or a dynamic monitoring system.

People generally use Accelerometers which can be uniaxial, biaxial and sometimes even triaxial if you want to monitor corrosion which can be a local phenomena, which can also be monitored continuously under static monitoring condition.

One can use scanning sensors to really know the state of condition of embedded reinforcement. One can also use embedded sensors to quantify the extent of corrosion on reinforcement.

So, friends there are varieties of monitoring systems and methods, which can be deployed to various purposes and varieties of sensors which cannot be used for application of monitoring in infrastructure industry.