

Structural Health Monitoring (SHM)
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Lecture – 45
Various sensor technologies – Part 2

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(L) Testing stage : Certain structures are subjected to test loads before they are actually put to functional use

- Railway bridges
- Highway bridges
- reservoir structures
- Coastal jetties
- Dockyards

- period of measurement - ① recording/sensor/stage of testing where load change is significant

Next level of monitoring can be add a testing stage. Certain structures are subjected to test loads before they are actually put to functional use. Examples can be railway bridges, highway bridges, reservoir structures, coastal jetties and dockyards.

So, here period of measurement is actually one recording per sensor per stage of testing where load change is significant.

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(5) period before reconstruction

- Monitoring is done several times a day at irregular intervals
- In addition, there can be a period monitoring which is continuous monitoring 24-48 hrs to determine effect of temp & load variations on the existing structure
- Based on the observation monitoring, reconstruction is demanded.

The slide also features the NPTEL logo in the top right corner and a small inset image of a man in a light purple shirt and glasses in the bottom right corner.

The next stage of monitoring can be in the period before reconstruction. In this case, monitoring is done several times a day at irregular intervals.

In addition, there can be a periodic monitoring which is continuous monitoring for 24 to 48 hours to determine effect of temperature and load variations on the existing structure. Based on this, monitor reconstruction is demanded.

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(6) during reconstruction

- period of monitoring can be 4 times/day/sensor for 24-48 hrs
- There can be many such session of recording during every stage of reconstruction.

(7) Long-term monitoring during the service of the structure

- period of monitoring can be at least 1 to 4 measurement/day/sensor
- one measurement/sensor/week to one/sensor/month
- yearly once, a continuous monitoring 24-48 hr, every 1000 hrs

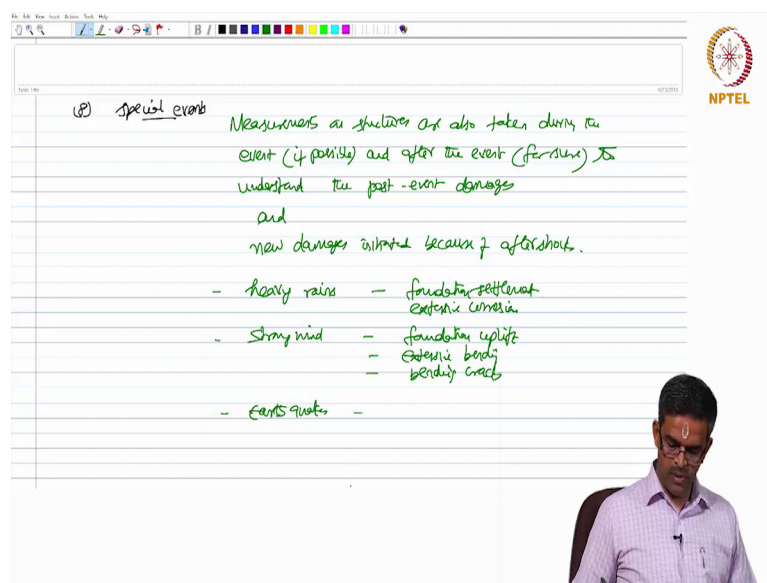
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The next stage of monitoring can be during reconstruction. During reconstruction, period of monitoring can be 4 times a day per sensor for 24 to 48 hours and there can be many

such sessions of recording during every stage of reconstruction. The next level of monitoring can be long-term monitoring which is done during the service life of the structure.

In this case, period of measurement can be or period of monitoring can be at least 1 to 4 measurements per day per sensor. Further, it can be one measurement per sensor per week to one per sensor per month. Then, it can extend to yearly once, the continuous monitoring of 24 to 48 hours that is every hour per sensor.

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(E) Special events

Measurements on structures are also taken during the event (if possible) and after the event (for sure) to understand the post-event damages and new damages initiated because of aftershocks.

- heavy rains - foundation settlement, extensive corrosion
- strong wind - foundation uplift, extensive bending, bending cracks
- earthquakes -

The last level of monitoring could be under special events. Measurements are also taken during the event, if possible and after the event for sure to understand the post event damages and new damages initiated; because of aftershocks.

This generally applicable to even such as heavy rains because heavy rains can cause foundation settlement, extensive corrosion etcetera; It can be also strong wind; it can also cause foundation uplift; the extensive bending stress.

Then, formation of flexural cracks etcetera can be during earthquakes etcetera. Now friends, the type of sensor which we choose depends upon the level of monitoring.

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Data Management

- managing the observed data
 - very crucial
- These data can be collected
 - manually
 - semi-automatic
 - complete automatic
- They can also be collected
 - on-site (or) by remote applications
 - periodically (or) continuously
 - static (or) dynamic modes

These options can also be combined

The next stage, in case of health monitoring is what we say as Data Management which is managing the measured data which is very crucial. Depending upon the type of monitoring the volume of data and the volume data to be processed and forwarded for further communication also varies. So, these data's can be collected by various modes manually.

It can be also by semi automatic means; can also be by complete automatic means. They can also be collected on site or by remote applications; can also be collected periodically or continuously; can also be collected either static or dynamic modes. Further it is important to see these options can also be combined.

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for example,
In case of a coastal jetty -
long-term monitoring, max/min performance observation
- which can be either automatic
or remote communication
- If the data is continuously monitored, then it is preferred
to handle the data without human intervention

For example, in case of a coastal jetty, long-term monitoring, can be combined with maximum minimum performance observation which can be either automatic or remote communication. If the data is continuous is continuously monitored, then it is preferred to handle the data without any human intervention.

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Data collection and Management

So, now let us see a quick layout. Data collection can be originated either from single source or multiple source. Multiple source can have sequential or parallel, let us say

simultaneous. The data now can be received in different modes like manual, semi-automatic or completely automatic.

These data's then will be fed to a source where can be non-scheduled; it can be scheduled. This data can now go to a source where there can be storage, there can be without storage. So, the data collection and management has a wide option of varieties of methods by which the data can be managed, which are actually collected from the monitored source of information during system process.

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The image shows a presentation slide with a white background and a blue grid pattern. The slide is titled "Summary" in the center. Below the title, there are four bullet points written in black ink:

- sensor technologies
 - different stages of health monitoring
- SHM analogy with human health
 - sensor requirements in SHM
- 8 stages of SHM
- Data collection & management can be varied in SHM process.

In the top right corner, there is a circular logo with the text "NPTEL" below it. In the bottom right corner, there is a small inset image of a man with glasses, wearing a light purple shirt, sitting in a chair.

So, friends we attempted to see different advancements in sensor technologies to understand a prior to that we must know what are the different stages of health monitoring. To understand this, we compared SHM analogy with human health and understood where are the sensor requirements in structural health monitoring.

We have seen about 8 stages of structural health monitoring. We have understood how the data collection and management can be varied in SHM process.

In the further lectures, we will talk about different kinds of advancements in the various sensors which are useful for monitoring of different types of structures.

Thank you very much and bye.