

Structural Health Monitoring (SHM)
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Lecture - 18

Part - 2: Short term and Long term Structural Health Monitoring (SHM)

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objective of SHM methods:

- (1) structural phenomenon such as corrosion, cracking, delamination, settlement effects should be inspected and investigated
- (2) Time Strategy such as continuous monitoring, periodic or triggered monitoring should be advised, based on the nature of defect/damage & type of the structure
- (3) Condition of the phenomenon whether it is local or global should be observed

Let us see what are the objectives; of structural methods. Structural phenomena such as corrosion, cracking, delamination, settlement effects should be inspected and investigated. The second objective should be time strategy such as continuous monitoring, periodic or triggered monitoring should be advised, based on the nature of defect, damage, and type of the structure. The third objective should be condition of the phenomenon whether it is local or global should be observed.

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4) Load-effects caused on the structures should be reported

5) Evaluation method should include

cause of failure and consequences of failure with respect to degree of severity should be reported

- this should cover
 - structural geometry
 - material degradation
 - load data etc.

Load-effects caused on the structures should be also reported. And finally, the evaluation method should include cause of failure, and consequences of his failure with respect to degree of severity should be reported. And this should cover problems related to material degradation, low data etcetera.

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let us consider deck of a bridge

i) vibration of deck slab

ii) formation of cracks, Membranes of crack widths

iii) excessive deformation/curved

iv) settlement of foundations

v) corrosion of rebar in the deck slab

deck slab

column capital

column

For example, let us consider deck of a bridge. Let us say in a toll and traffic bridge is also supported by columns and piers, and that is the deck slab; these are column, is what we call as column capital and so on.

What would be the parameters, which will be observed on this bridge in terms of health monitoring? The parameters could be vibration of the deck slab, excessive deformation of the deck, formation of cracks or measurement of crack widths, if a water reinforcement corrosion of river in the deck slabs settlement the foundation. So, about 5 to 6 parameters can be a focal item of health monitoring of a traffic bridge as you see in this slide.

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Monitoring

- i) short-term
- ii) long-term monitoring
- iii) triggered

Short-term monitoring (STM)

- can be used if the state of structure to be examined only @ specific point of time (road/railway bridge, monitoring is required only when there is a heavy traffic)
- can also be done if visual inspection shows a damage definitely
 - STM is carried out to validate/collect more details about the damage

Long term and triggered monitoring: let us see each one of them separately detail; what do you understand by short-term monitoring. This can be used if the state of structure to be examined only at specific point of time, I can give an example, if you are looking for a road or a railway bridge, then monitoring is required only when there is a heavy traffic. Short term monitoring can also be done, if visual inspection shows damage definitely. So, in such cases short-term monitoring is carried out to validate and collect more details about the damage.

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Most of the sensors used in STM are not robust and unable to sustain long-periodic observations. Due to this reason, sensors are used in STM only for a specific period of time. They are generally used in "on-off" mode.

- Several short-term monitoring, if repeated at periodic intervals can be a substitute to periodic or long-term monitoring.

The slide includes the NPTEL logo in the top right corner and a photograph of a man in a white shirt and glasses in the bottom right corner.

Most of the sensors used in short-term monitoring, robust and unable to sustain long-periodic observations. Due to this reason, sensors are used in short-term monitoring only for a specific period of time. They are generally used in on-off mode. It is interesting to know that several short-term monitoring, if repeated at periodic intervals can be a substitute to periodic or long-term monitoring.

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Long-term monitoring

When the period of monitoring is very large, it is termed as long-term monitoring (Mufti et al 2006)

Mufti A. A., Oshima, T., Bakht B., Mohammed A., Mohammed M.A. 2006.
Structural Health of Monumental Structures,
Proc. of European Workshop on SHM,
Paris, France ISBN: 1-932678-08-0.

- Long-term monitoring is carried out over the entire life of the structure.

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Long-term monitoring; when the period of monitoring is very large, this is termed as long-term monitoring, as stated by Mufti et al 2006. Mufti A A, Oshima T, Bakht B,

Mohammed A, and Mohammedin A A, Mohammedien M.A- 2006, stated this in a paper structural health of monumental structures, proceedings of European workshop on SHM, Paris, France which has an ISBN number of the publication. So, according to the researchers, long-term monitoring is carried out, over the entire life of the structure.

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Specific conditions under which long-term monitoring is done.

- If changes in loading are slow such as gradual change in temperature
- To predict effect of natural hazards on the structural systems
 - earthquakes, flood, hurricane etc

There are specific conditions, under which long-term monitoring is done. Firstly, if changes in loading are slow such as gradual change in temperature, then one should go for long-term monitoring. In order to predict effect of natural hazards on the structural systems, one should go for natural long-term monitoring. For example, we want to find the effects of earthquakes, floods, hurricane etcetera, then one should monitor the health of structure over a continuous period of time.

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Triggered monitoring

This is done when data collection is initiated by a specific event

or

when a parameter exceeds threshold value

- Sampling interval depends on dynamic nature of the studied phenomenon

Typical example: monitoring the vibrations when train passes a railway bridge.

The third could be a triggered monitoring. This is done when the data collecting is initiated by a specific event or when a parameter exceeds a preset threshold value. In triggered monitoring, sampling interval depends on the dynamic nature of the study or examined phenomenon. A typical example could be, monitoring the vibration, when train passes a railway bridge that is a typical example of application of a triggered monitoring.

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continuous ———— Long-term monitoring ———— time

frequent periodic monitoring ———— time

Triggered monitoring ———— time

Graphically this can be expressed like this. Say this is my time scale, this is expression of continuous monitoring, where I essentially do a long-term monitoring of a parameter.

Can also do a periodic monitoring, if this is my time scale, I monitor the parameter at constant intervals of time over a large period of time; this is what I call, frequent periodic monitoring. Alternatively on a time scale, whenever the event is triggered, I keep on measuring the parameter; here the interval may not be equal, so monitoring is triggered, when the parameter exceeds the threshold value.

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The image shows a digital whiteboard interface with a toolbar at the top. The main content is handwritten text in black ink. At the top center, the word "Summary" is written and underlined. Below it, the text reads "Glossary of Terms - SHM - types of monitoring". To the right of this, there is a vertical line that separates the list of monitoring types from a note. The list includes: "short-term", "long-term", "periodic", and "triggered monitoring". To the right of the vertical line, the text says "why SHM - is necessary for ageing structures". In the top right corner of the whiteboard, there is a circular logo with a star-like pattern and the text "NPTEL" below it. In the bottom right corner of the whiteboard area, there is a small video inset showing a man with glasses and a light-colored shirt, looking towards the camera.

So, friends in this lecture, we learned some of the glossary of terms in structural health monitoring related to some types of monitoring, and terminology used in this monitoring. We also learned something about short-term, long-term, periodic, and triggered monitoring. We also understood that why structural health monitoring is necessary for ageing structures and so on.

In the next lecture, we will try to continue with the types of monitoring methods and type of SHM in detail.

Thank you very much.