Structural Health Monitoring (SHM)
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Lecture – 31
Damage identification by visual Inspection method – Part 1

Friends, welcome to the 8th lecture in module 2.

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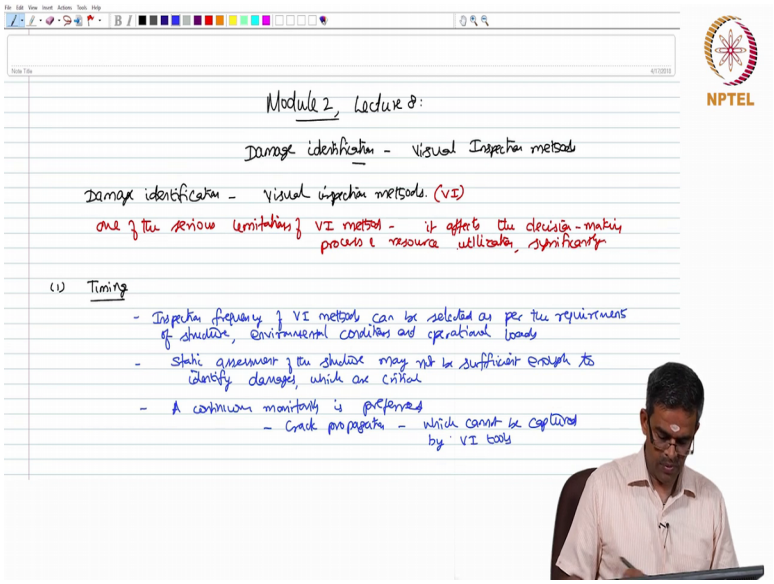

In this lecture, we are going to discuss about Damage identification. But, we are going to pay emphasis on Visual Inspection methods and compare this with Structural Health Monitoring conventional methods.

Now friends, Damage identification can also be done using visual inspection methods. One of the serious limitations of visual inspection method is that it affects the decision making process and resource utilization, significantly.

Let us see on what background we can compare the visual inspection method and try to understand the pros and cons of this method as applicable to damage identification. The foremost issue will be the timing interval; that is the inspection frequency of visual inspection methods can be selected as per the requirements of the structure, environmental conditions and operational loads.

It is important to note that the static assessment of the structure may not be sufficient enough to identify damages which are critical. Therefore, a continuous monitoring is preferred.

For example, crack propagation which cannot be captured by visual inspection tools.

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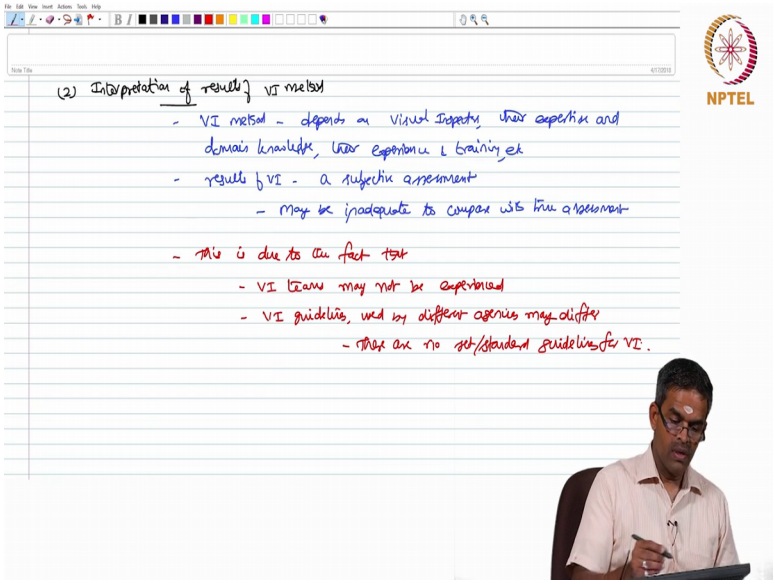

The second major issue is the interpretation of results of visual inspection method. Visual inspection method strongly depends on the visual inspectors, their expertise and domain knowledge, their experience and training etcetera.

So, what we want to say here is the results of visual inspection or a subjective assignment which may be inadequate to compare with true assessment. Mainly this is due to the fact; visual inspection team teams may not be may not be experienced.

That could be the reason. Second could be visual inspection guidelines used by different agencies may differ. So, there are no set standard guidelines for visual inspection.

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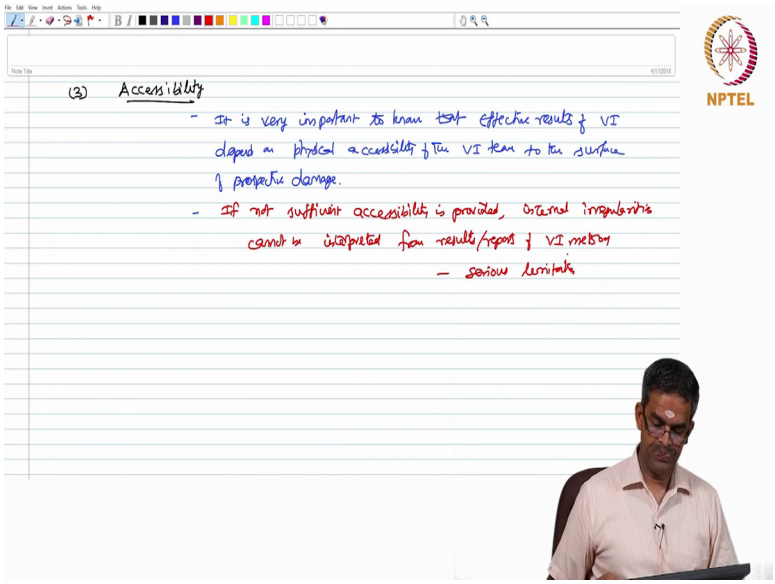

The third could be the accessibility. It is very important to know that effective results of visual inspection depend on the physical accessibility of the visual inspection team to the surface of prospective damage. That is one issue. If we are not able to if not sufficient accessibility is provided internal irregularities cannot be interpreted from the results or reports of visual inspection method.

This is a very serious limitation. Friends, let us see what are the different types of sensors being used for, measuring various parameters.

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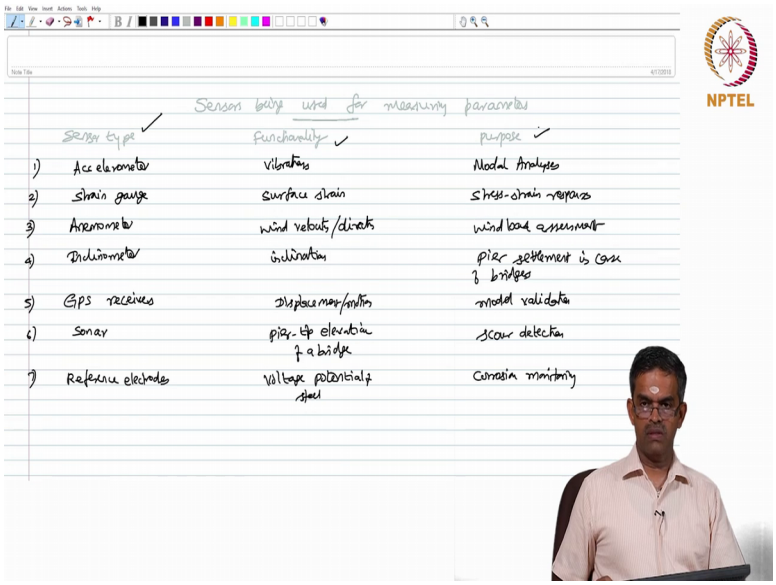

Let us open up a table. Sensor type, its functionality and the purpose of the sensor; Let us say Accelerometer. The purpose is to measure vibrations. It can be useful in modal analysis. Second could be a Strain gauge.

The functionality is to measure surface strain. It can be used to analyze the strain responses. The third sensor type could be Anemometer, which can measure wind velocity and direction useful in wind load assessment.

The forth could be an Inclinometer, which actually measures inclination, which is useful to characterize the pier settlement in case of bridges. Fifth could be sensor of GPS receivers. The functionality is to measure displacement and response. It can be used for model validation. The next could be Sonar. This is useful in measuring pier tip elevation, maybe of a bridge.

It is useful in detecting scour of the bridge piers. Next could be Reference electrodes. They can measure voltage potential of steel. They are helpful in corrosion monitoring. So, various type of sensors and their functionality and the purpose of use of the sensors in health monitoring is discussed in this table.

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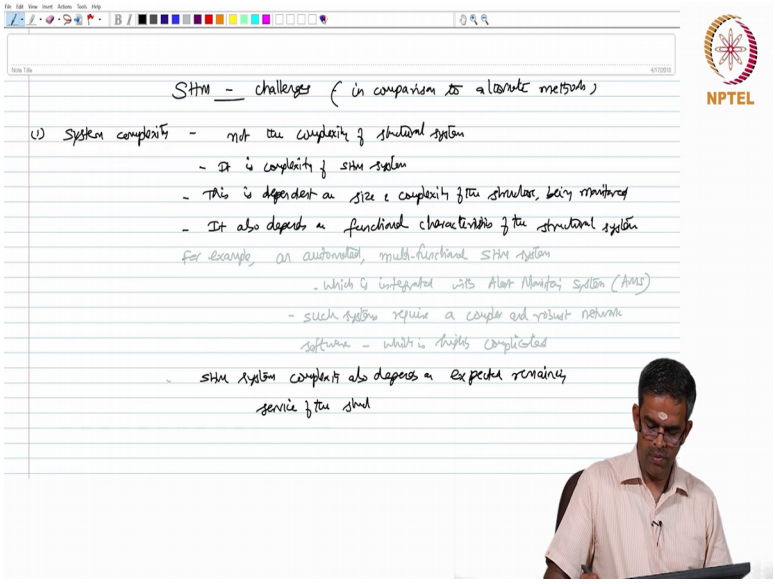

Now, let us take a question on Structural Health Monitoring challenges.

We already discussed this in the previous module as well. But this will be in comparison to alternate methods for health monitoring may be for example, visual inspection is also

one of the methods based on which a structural health monitoring can be done. So, we will compare this in terms of imposing challenges on SHM.

The first challenge which comes in SHM is that the system complexity. Here we are not talking about the complexity of structural system. It is not the complexity of structural system. Rather it is complexity of SHM system. Actually this is dependent on size and complexity of the structure being monitored. It also depends on the functional characteristics of the structure.

Let us take for example, an automated multifunctional structural health monitoring system, which is integrated with Alert Monitoring system. Now such systems require a complex and robust network software which is highly complicated. The system complexity that is a SHM system complexity also depends on the expected remaining service of the structure.

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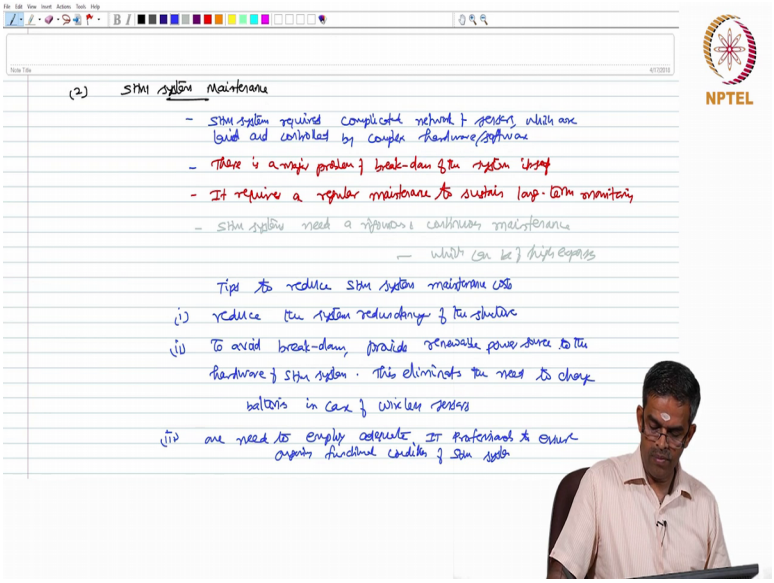

The next issue could be SHM system maintenance. In fact, SHM system requires complicated network of sensors which are laid and controlled by complex hardware and software. Now, there is a major problem that there is a major problem of breakdown of the system itself.

Therefore, it requires a regular maintenance to sustain long-term monitoring. Now, SHM systems need a rigorous and continuous maintenance which can be of high expense.

So, there are some tips to reduce SHM system maintenance costs. Let us see what are they? One, reduce the system redundancy of the structure. Two, to avoid total breakdown provide renewable power source to the hardware of SHM systems.

Actually this eliminates the need to change battery in case of wireless sensors, otherwise they will become de-functional. The third point could be one need to employ adequate IT professionals to ensure ongoing functional condition of SHM system.

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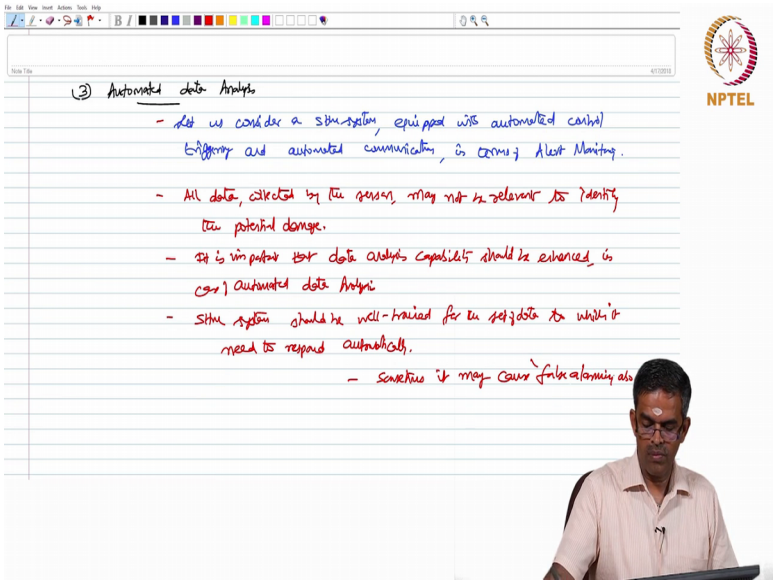

The third area which talks about challenges is in case of automated data analysis. Let us talk about or let us consider here SHM system equipped with automated control triggering and automated communication in terms of alert monitoring. It is very important to know that all data collected by the sensors may not be relevant to identify the potential damage.

Therefore, it is important that data analysis capability should be enhanced in case of automated data analysis. Further, SHM system should be well trained for the set of data to which it need to respond automatically. Sometimes it may cause false alarming also. The next question comes in limitation is liability and responsibility.

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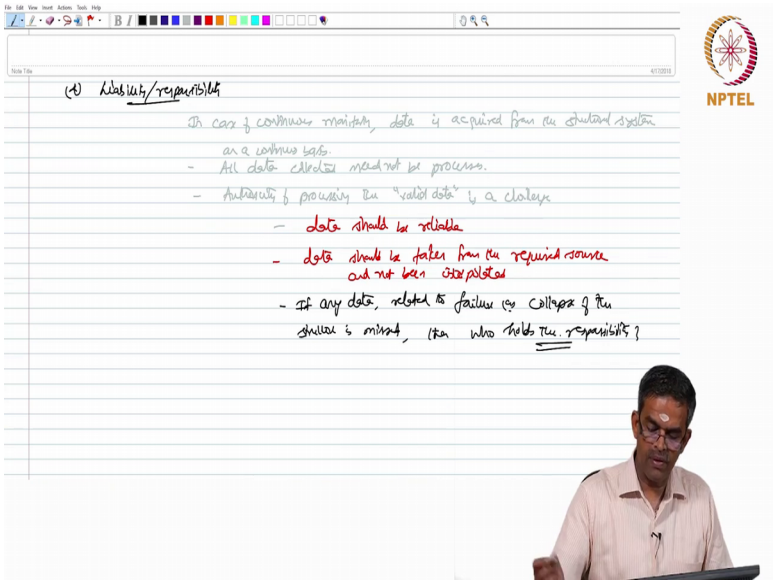

It is very important that in case of continuous monitoring, data is acquired from the structural system on a continuous basis. In that situation, all data collected need not be processed. Therefore, authenticity of processing the I will say “valid data” is a challenge.

Because the data should be reliable; the data should be taken from the required source and not been interpolated. It is the direct field data. For example, if any data related to failure or collapse of the structure is missed by any chance. Then, who holds the responsibility? Because is automated and it is processed automatically. So, that becomes a major accountability.