Structural Health Monitoring (SHM)
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Lecture - 23
Part 1: Structural Health Monitoring (SHM) Planning and Management

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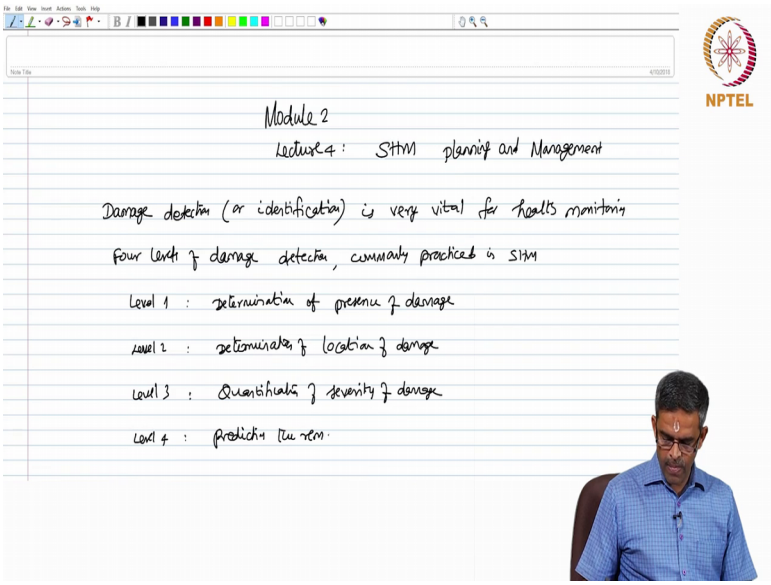

Welcome to the next lecture in module 2 which is lecture 4, where we are going to talk about structural health monitoring planning and management.

Damage detection or identification is very vital for health monitoring. There are four levels of damage detection which are commonly practiced in health monitor; designated as level 1, level 2, level 3, and level 4. Level 1 deals with determination of presence of damage, level 2 deals with determination of location of damage, level 3 deals with quantification of severity of damage and level 4 deals with predicting the remaining service life of the structure.

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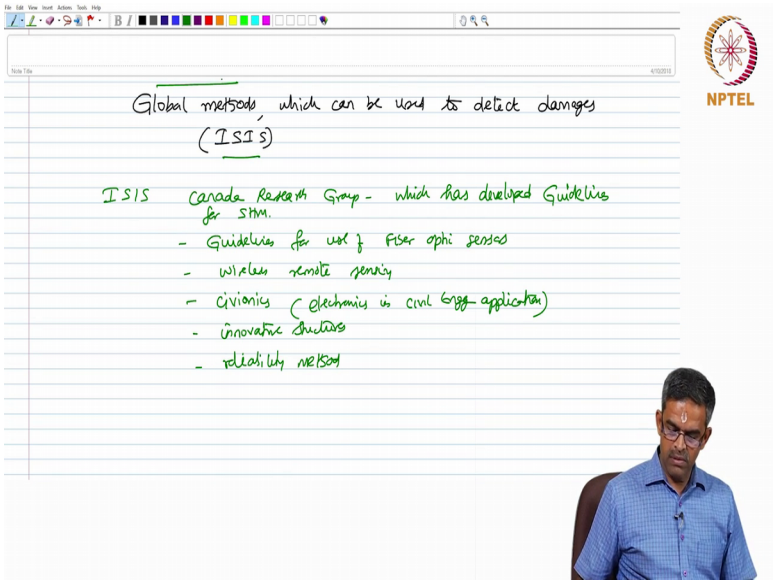

There are many global methods which can be used to detect damage they are recommended by ISIS. Now, what is ISIS? ISIS is Canada Research Group which has developed guidelines for structural health monitoring. They also have guidelines for use of fiber optic sensors, guidelines for wireless remote sensing, guidelines for civionics that is electronics in civil engineering application. They also have guidelines for health monitoring of innovative structures and reliability methods.

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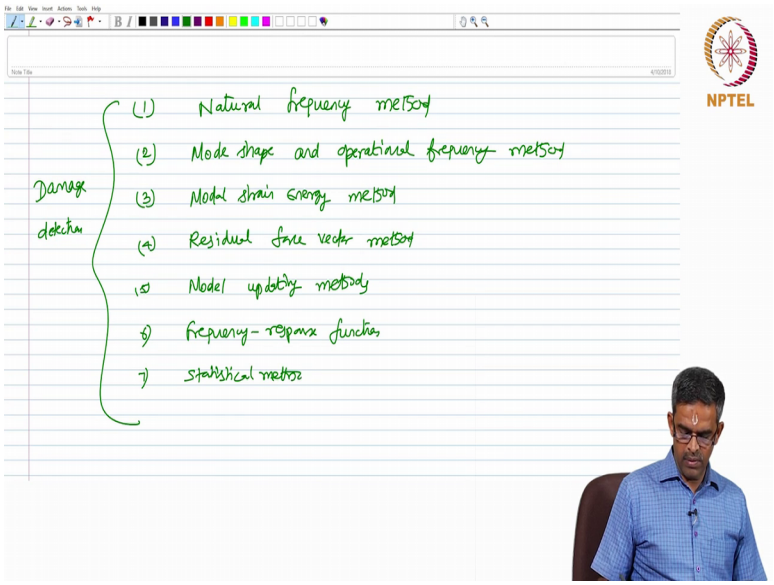

ISIS have recommended many global methods for damage detection. Let us see what are they? One can detect image based on natural frequency. You can also detect damage by observing the mode shape and operational frequency. One can also detect damage based upon the model strain energy, can also use residual force vector method to detect damage, one can also use model updating methods for detecting damage. These methods are all for damage detection.

One can use frequency response function alternatively one can also use statistical methods.

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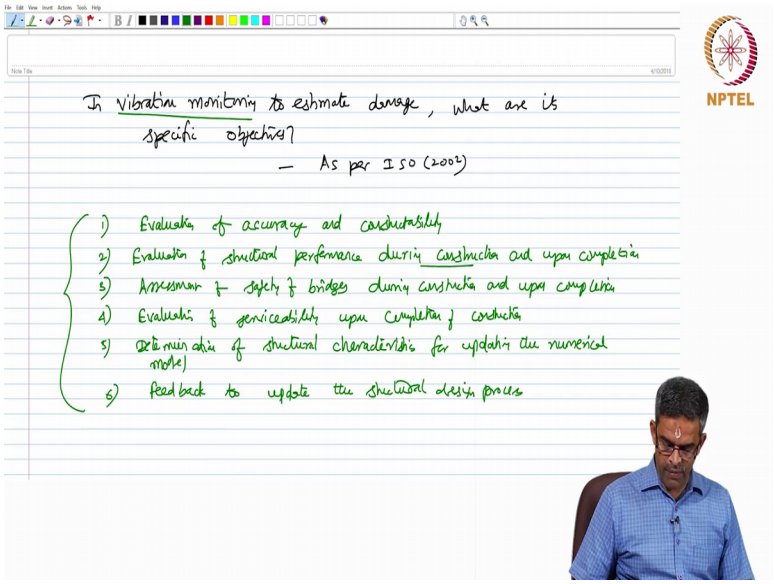

Now, the question comes before we start planning for SHM and managing the structural health monitoring process. Let us ask a question, if I am going to do vibration monitoring to estimate damage in a given system then what are its specific objectives, what should I look when I do damage detection using vibration monitoring. This is clearly defined in ISO 2002 we says the objectives are evaluation of accuracy and constructability, evaluation of structural performance during construction and upon completion that is very very interesting.

Even the construction stage damage detection can be initiated, assessment of safety of bridges during construction and upon completion because damage can be caused by construction activities as well, evaluation of serviceability upon completion of

construction determination of structural characteristics for updating the numerical model, and finally to create a feedback to update the structural design process.

These are the key objectives of any vibration monitoring scheme which essentially is devised to detect damage in a given system, structural assessment algorithm structural health monitoring of civil engineering structures.

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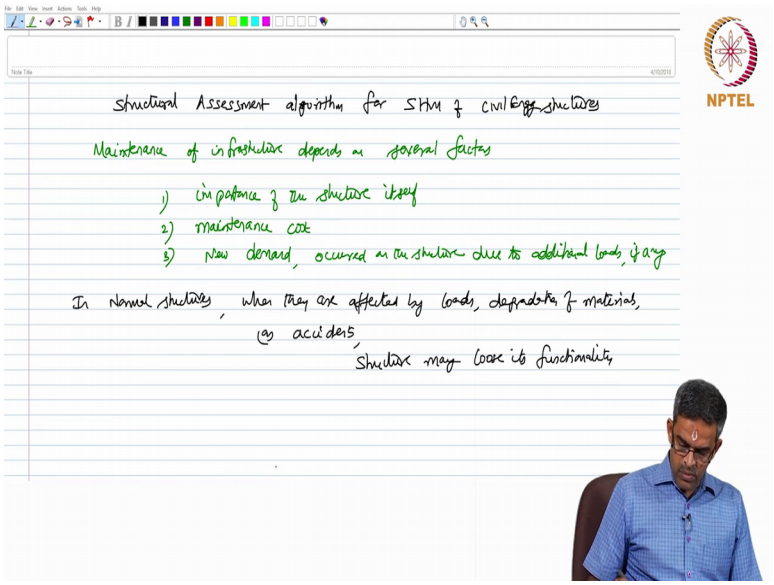

We do agree on a major issue that maintenance of infrastructure depends on several factors; 1 the importance of the structure itself, 2, cost of maintenance and 3, the new demand which has occurred on the structure due to additional loads, if any.

In normal structures, when they are affected by loads degradation of material are accidents the structure may lose its functionality it may not collapse, but the functional performance of the structure may get degraded.

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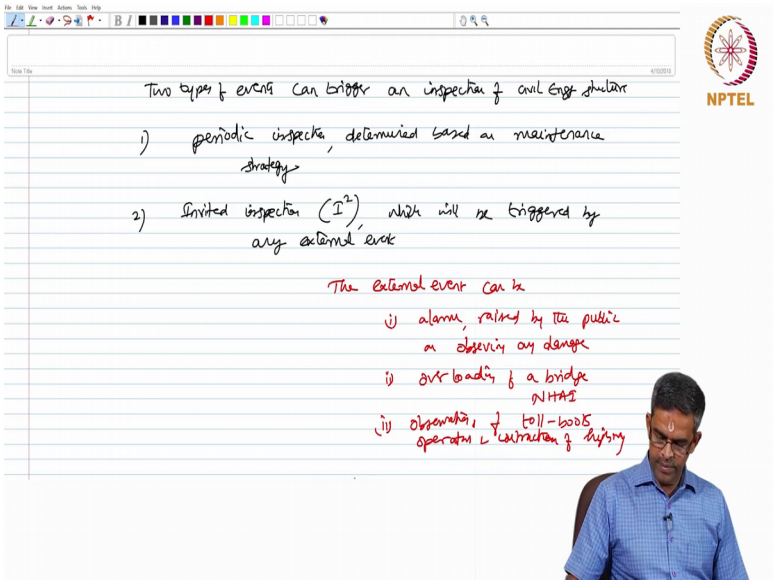

So, two types of events can trigger an inspection of a structure namely; periodic inspection which is determined based on the maintenance strategy, second is called invited inspection I square, which will be generally triggered by any external event. The external event can be an alarm raised by the public on observing any damage. It can be overloading let us say of a bridge in NHAI. 3, it can be observations of toll booth operators and contractors of highway. In case of railway it can be permanent way inspectors.

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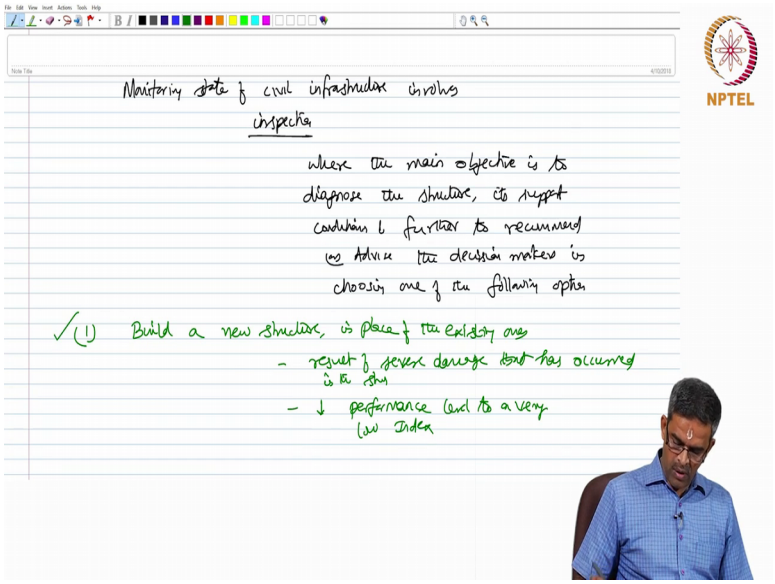

Therefore, friends, the monitoring state of civil infrastructure involves inspection, where the main objective is to diagnose the structure, its support conditions and further to recommend or advice the decision makers in choosing one of the following option. One can go for to build a new structure in place of the old one. This can be result of severe damage that has occurred in the structure. It has reduced the performance level to a very low index. In such situation inspection can recommend rebuilding of a new structure.

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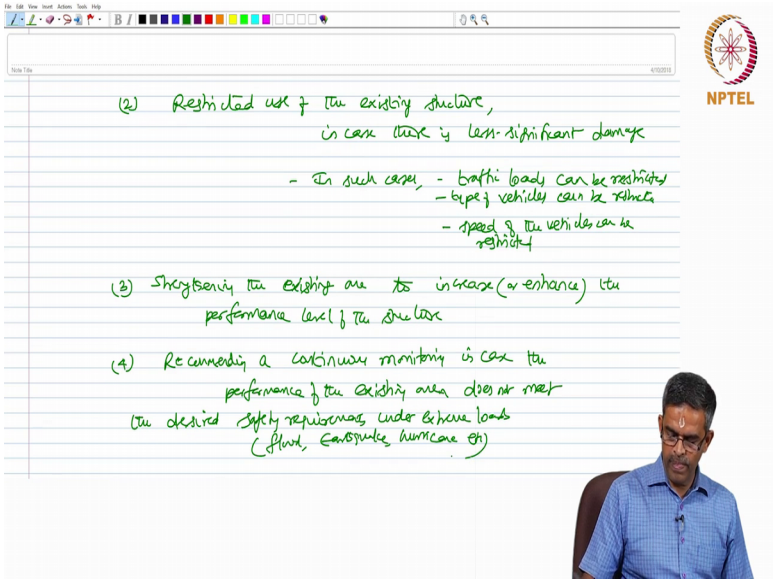

Alternatively, it can also recommend restricted use of the existing structure. In case there is less significant damage. They may not abandon the structure, but they may restrict the use of the structure there is a very common situation. In such cases, traffic loads can be restricted, type of vehicles on the bridges can be restricted, speed of the vehicle can be restricted. Third option could be strengthening the existing one to increase or enhance the performance level of the structure.

The forth could be recommending a continuous monitoring in case the performance of the structure that is the existing ones does not match or does not meet the desired safety requirements under extreme loads such as flood, earthquake, hurricane etcetera.

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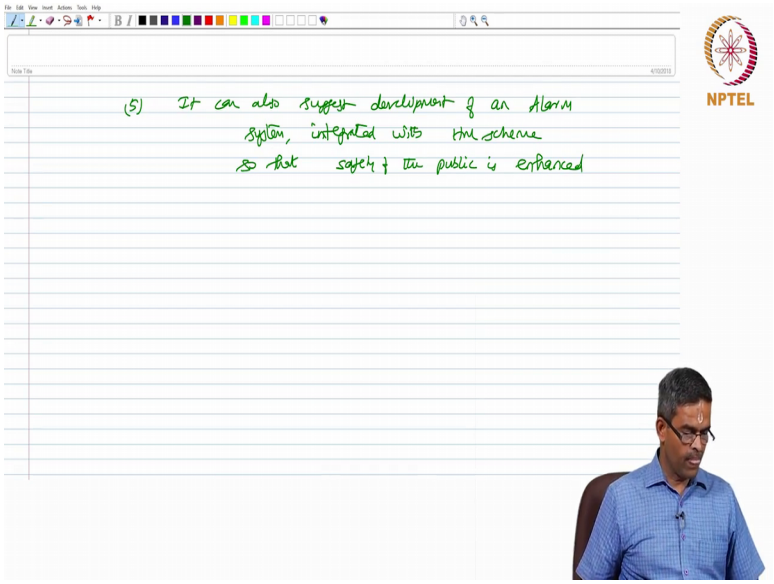

Lastly, it can also suggest development of an alarm system integrated with the health monitoring scheme so that safety of the public is enhanced.