Structural Health Monitoring (SHM)
Prof. Srinivasan Chandrasekaran
Department of Ocean Engineering
Indian Institute of Technology, Madras

Lecture – 12
Components of Structural Health Monitoring Process – Part 2

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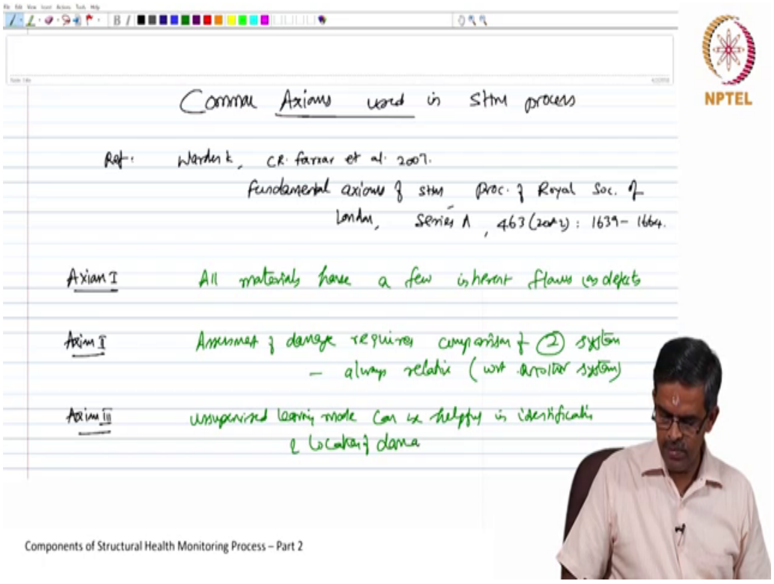

Friends, there are some common axioms used in a SHM process, which are quite interesting and very useful ok. This as a reference let us see what are these axioms. Axiom 1, all materials have a few inherent flaws or defects; I mean there is no material without defect. Axiom 2, assessment of damage requires comparison of 2 systems. So, damage assessment is always relative that is with respect to another system. So, it is on the comparison mode only. Axiom 3, unsupervised learning mode, which we saw in the last slide, can be helpful in identification and location of damage.

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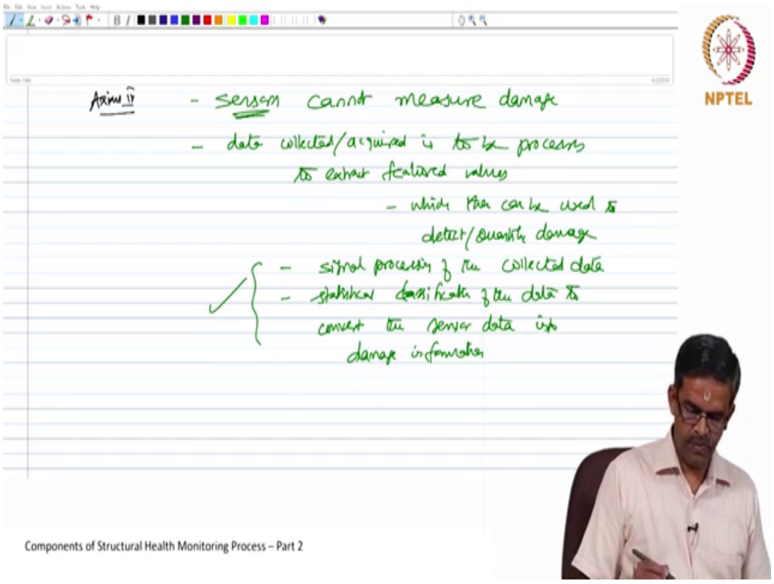

Axiom 4, the very important, sensors cannot measure damage, please understand this. Based on the data collected or acquired is to be processed to extract featured values, which then can be used to detect quantify damage. So, the vital part is not the sensor, the vital part is signal processing of the collected data that is the first part. The second part is statistical classification of the data to convert the sensor data into damage information. So, it is not the sensor which is important, it is the processing which is important.

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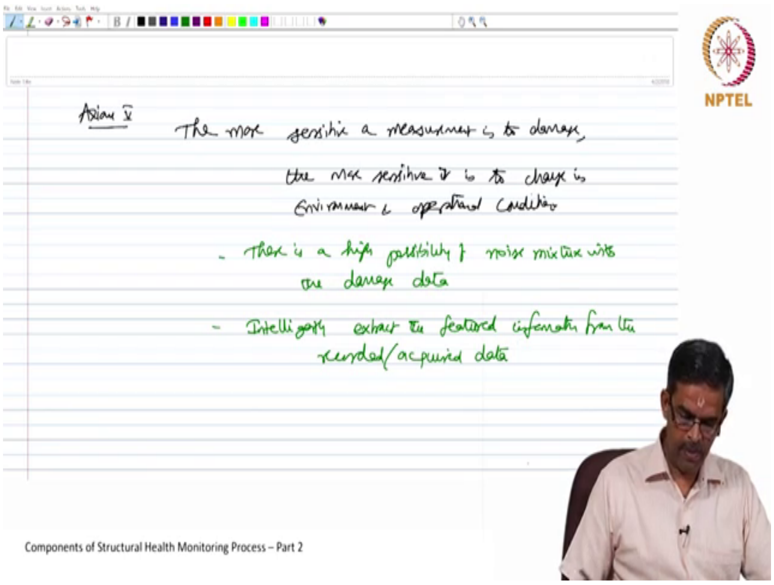

Axiom 5, the more sensitive a measurement is to damage, the more sensitive it is to change in environment and operational conditions. What does it mean? It means that there is a very high possibility of noise mixture with the damage data. Hence, it is important that one should intelligently extract the featured information from the recorded or acquired data.

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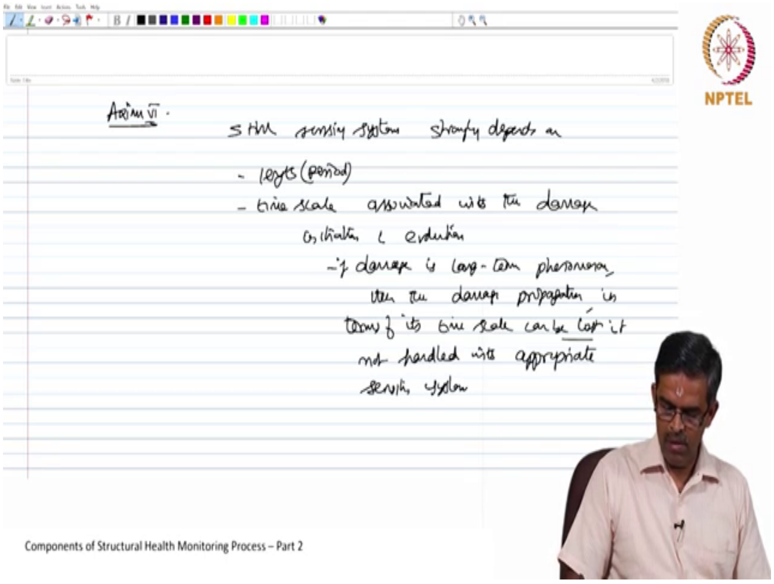

The 6th axiom, relates to sensing system. The SSM, Sensing System strongly depends on length that is period, and time scale associated with the damage initiation and evolution. For example, if a damage is long term phenomenon, then the damage propagation in terms of its time scale can be lost; if not handled with appropriate sensing system.

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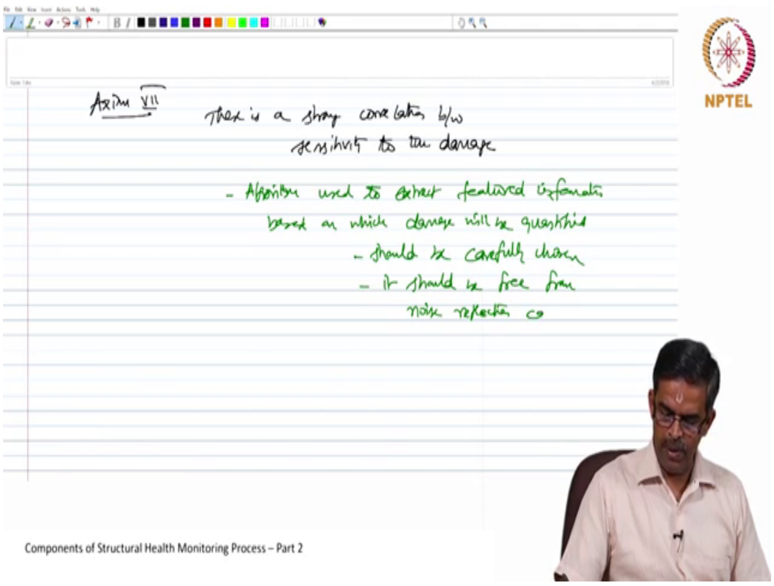

Axiom 7, there is a strong correlation between sensitivity to the damage. Therefore, algorithm used to extract featured information based on which damage will be quantified, should be carefully chosen and it should be free from noise reflection capability.

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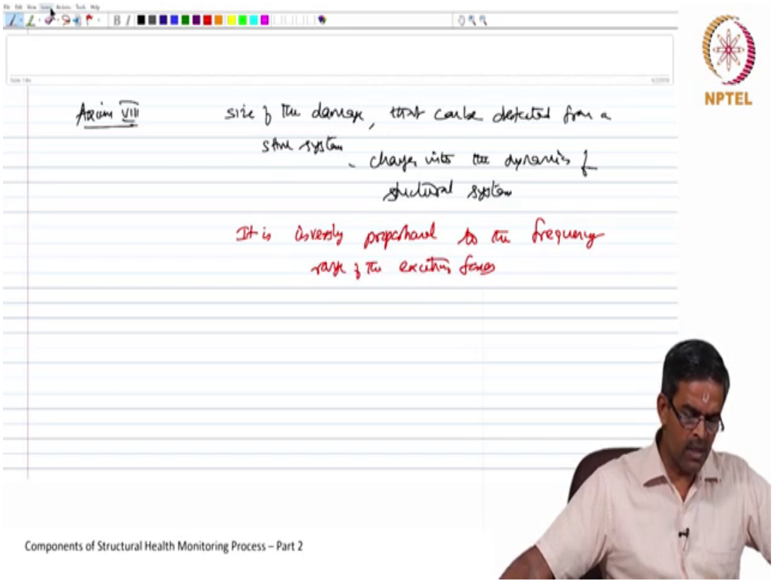

Axiom 8, size of the damage that can be deducted from a system changes with the dynamics of the structural system. It is actually inversely proportional to the frequency range of the exciting force. Let us friends quickly see, some of the interesting example applications of SHM in the recent past.

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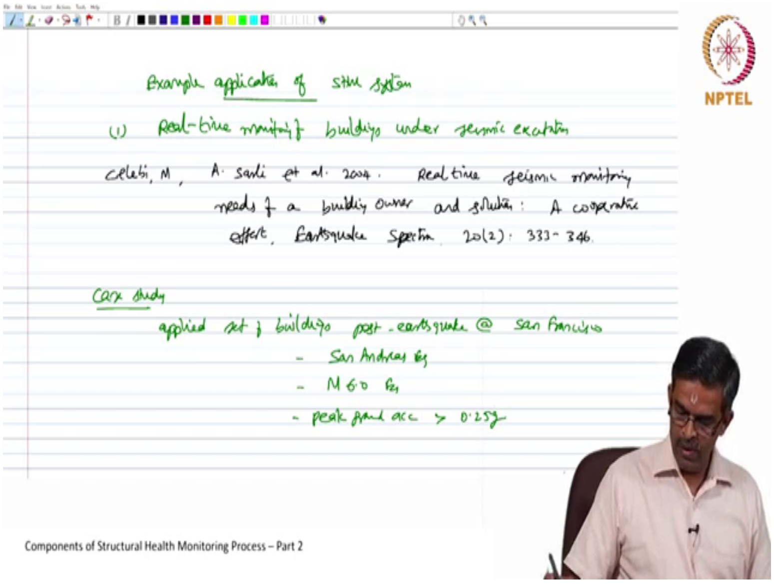

As a first case, we will talk about something on real time monitoring of buildings under seismic excitation. This was well presented by Celebi et al earthquake spectra, 20 2 333-346. Let us see actually it is a case study, which is applied to set of buildings post-earthquake at San Francisco. This is actually a post-earthquake of San Andreas, which is a magnitude of 6.0 earthquake, the peak ground acceleration of this earthquake, exceeded 0.25 g, which is expected to cause, considerable damage to different varieties of buildings in San Francisco.

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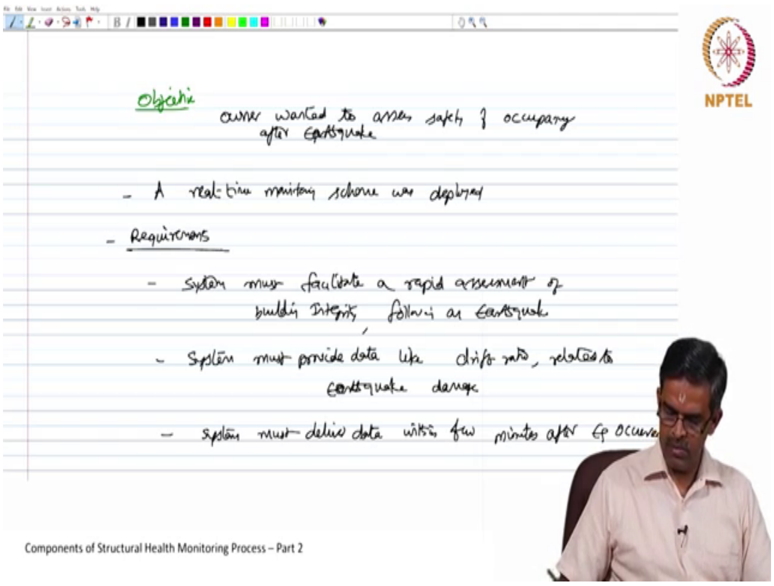

So, the objective was that the owner of the buildings or public buildings, wanted to really assess safety of occupancy after the earthquake; that was the main object. So, to do this a real-time monitoring was deployed. The requirements of this scheme whereas follows, one the systems must facilitate a rapid assessment of building integrity based on which the occupancy safety can be declared following in earthquake ok. That is the first requirement of the system, SHM system.

The second is the SHM system must provide data like drift ratio, which is related to earthquake damage. So, they can be used as an indices to quantify the occupancy level of the system post-earthquake. SHM should also have capably deliver data within few minutes after earthquake occurred ok; these are the requirements of the system.

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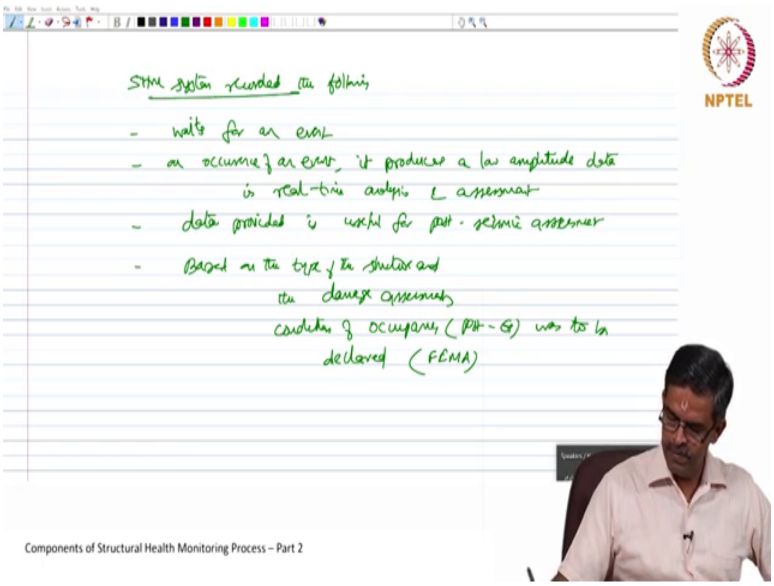

What are recorded? SHM system recorded the following, the system waits for an event, once the event occurs; it produces a low amplitude data, in real time analysis, and starts making assessment of the data. Data provided by the system is very useful for post seismic assessment. Based on the structural type and the damage assessment made condition of occupancy, post-earthquake was to be declared. Different guidelines are available FEMA is one amongst them, etcetera.

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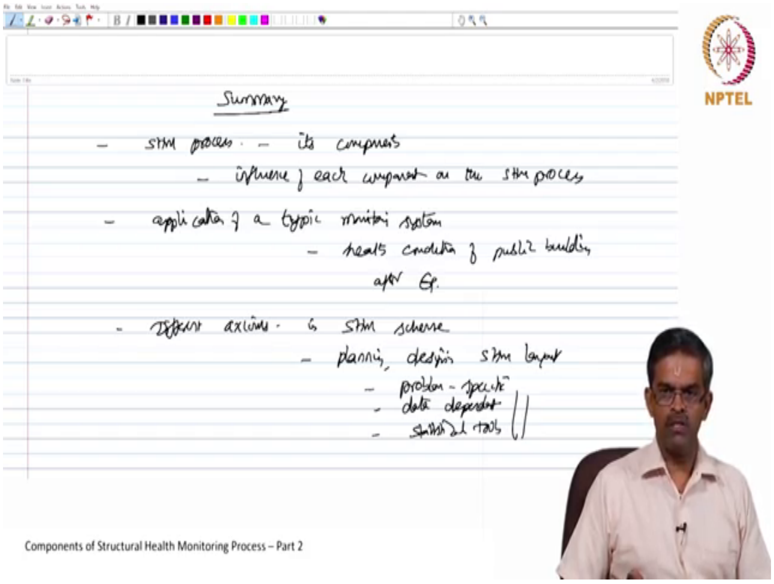

So, friends, let us quickly see the summary, what we learnt in this lecture. We talked about the SHM process and its components. We also discussed about influence of each component on the efficiency of SHM process. We also talked about, the application example of a typical monitoring system, which can be used for declaring and assessing health condition of a structure let us say a public building, after an earthquake. We also discussed different axioms, which are prevailing in structural health monitoring scheme, which are very useful in planning, designing a SHM layout, which is actually problem specific, data dependent and of course depends on the possibility of statistical tools, which can make the data viable for estimating the service life of the structure.

So, in the next lecture, we will talk about some of the important complications what an SHM process can have when applied to concrete structures ok. Concrete is of course, an anisotropic material which has got complexity of its own. So, what could be the challenges of SHM scheme, when deployed on concrete structures we will discuss them in detail, and we also see what are the different non-destructive evaluation methods, which are useful for concrete structures in particular in the next lecture.

Thank you very much.