

Structural Health Monitoring (SHM)
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Lecture – 32
Damage identification by visual Inspection method – Part 2

Let us pick up certain important issues.

(Refer Slide Time: 00:21)

Certain important issues to compare visual inspection methods & SHM methods

(1) Functionality

Overall functionality of the full scale SHM and VI are not exclusively different

one important difference is the frequency interval at which VI is carried out

- VI has discrete & infrequent time intervals whereas SHM methods have preset time intervals (or) continuously monitored
- SHM methods have potential to generate information even on a daily basis (VI methods cannot do this)

The one which we discussed earlier were general issues, certain important issues to compare visual inspection methods and structural health monitoring methods. Let us say to take some critical issues and compare them. The first issue which requires comparison is functionality.

If you look at in real sense, overall functionality of the full scale SHM and visual inspection are not exclusively different. But, one important difference is the frequency or the interval at which visual inspection is carried out.

Visual inspections have discrete and infrequent time intervals. Whereas, structural health monitoring methods have preset time intervals or they may be continuous monitoring continuously.

So, therefore, structural health monitoring methods have potential to generate information even on a daily basis. Visual inspection methods cannot do this.

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one major functional advantage of vi method is that
the scope of vi method is not only limited to damage
detection, but leads to broad evaluation of the
complete structure (preliminary assessment of the st
is possible with vi)

Even completely automated shm methods cannot execute
or extend the damage detection scenario to the
complete structure

But interestingly, one major functional advantage of visual inspection method is that the scope of visual inspection method is not only limited to damage detection.

But it also leads to broad evaluation of the complete structure; that is a preliminary assessment of the structure is possible with visual inspection. But interestingly, even completely automated SHM methods cannot you execute or extend the damage detection scenario to the complete structure.

So, as far as the functionality is concerned, there are some pros and cons of using visual inspection methods in comparison to the standard conventional structural health monitoring methods. Further let us talk about the second issue which is the cost.

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(2) Cost

In both the cases, i.e. VI method and SHM method, cost depends on characteristics of the structured monitored or assessed

- Cost implementation of SHM system - will be very high if it is not required for the structural system
- SHM methods - structures of high importance
- VI methods can be applied to all types of structures
- cost of VI is subjected to the extent of details required from VI

In both the cases that is visual inspection method and structural health monitoring method, cost essentially depends on the characters of the structured analyst monitor or I should say assessed. However, cost implementation of SHM system will be very high; if it is not required for the structural system. It means SHM methods are applicable generate structures of high importance; I mean all structures cannot be and need not be monitored.

Because, it is very very expensive, it is prohibitively high. Whereas, visual inspection methods can be applied to all types of structures; cost of visual inspection is subjected to the extent of details required from the visual inspection.

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- It also depends on inspection frequency

There are 3 factors, based on which cost can be compared

- (1) Upfront cost
- (2) Maintenance/operational cost
- (3) Return on Investment (ROI)

It also depends on the inspection frequency. There are three factors based on which cost can be compared. One is the upfront cost; second is the maintenance cost. I should also say operational cost; third could be the return on investment. Let us now compare and contrast both the methods based on these parameters and see how do they argue upon.

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Cost Comparison

STM methods	VI methods
(1) Negativity of the upfront cost is towards hardware/software compared	(1) Major cost is towards labour (technical experts) and advanced equipments to conduct VI
(2) Maintenance cost depends on the longevity and health of the structure - cost towards data acquisition & data management	(2) To such, there is no special operational cost involved - except, in case of inaccurate location, labour need to be insured.
(3) ROI is slow - effectiveness of STM will be realized only when the maintenance cost is compared to reliability cost	(3) ROI is quick & visual - Immediate perception of the VI result based on which maintenance/repair is initiated

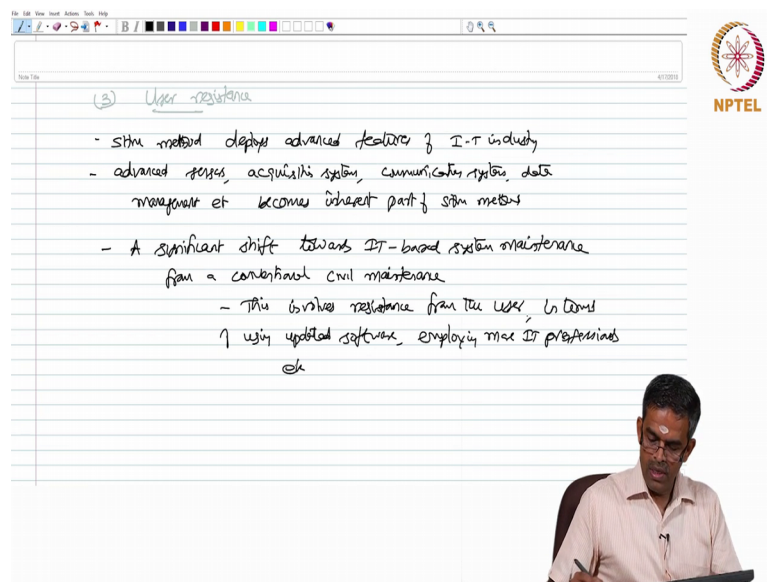
Let us talk about structural health monitoring methods on the left hand side and Visual Inspection methods on the right hand side. We are comparing the cost, I should say here cost comparison.

Firstly, majority of the upfront cost in SHM method is towards hardware and software components; that is the first issue here. In this case the major cost is towards labour. I should say even technical expertise of the labour and use of advanced equipments equipments to conduct visual inspection.

The second issue here is maintenance cost depends on the longevity and health of the structure. That is the cost is essentially towards data acquisition and data management. In this case as such there is no special operational cost involved except in case of in accessible locations like offshore structures, the labour need to be insured that may be slightly a marginal increase in operational cost when we do it for special kinds of structures.

The third point could be the return on investment is slow in case of SHM. This is due to the fact that the effectiveness of SHM will be realized only when the maintenance cost goes down in comparison to rebuilding cost. In this case the return on investment is quick and visual. This is due to the fact that there is an immediate perception of the VI results based on which maintenance or repair is initiated.

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The image shows a digital whiteboard interface with a toolbar at the top. The main content area contains handwritten text in black ink. The text is organized into a list under the heading '(3) User resistance'. The list items are: '- SHM method deploys advanced features of I-T industry', '- advanced sensors, acquisition system, communication system, data management etc become inherent part of SHM method', '- A significant shift towards IT-based system maintenance from a conventional civil maintenance', and '- This involves resistance from the users in terms of using updated software, employing more IT professionals etc'. To the right of the whiteboard is the NPTEL logo. In the bottom right corner, there is a video inset showing a man in a light-colored shirt and glasses, sitting at a desk and speaking.

The third point based on which the visual inspection and SHM can be compared is user resistance. It is very important to note that SHM method deploys advanced features of IT industry ok; advanced sensors, acquisition systems, communication systems, data management etcetera becomes inherent part of SHM method.

Therefore, it is important that there will be a significant shift towards IT based system maintenance from a conventional civil maintenance. So, this involves resistance from the user in terms of using updated software, employing more IT professional's etcetera.

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VI method

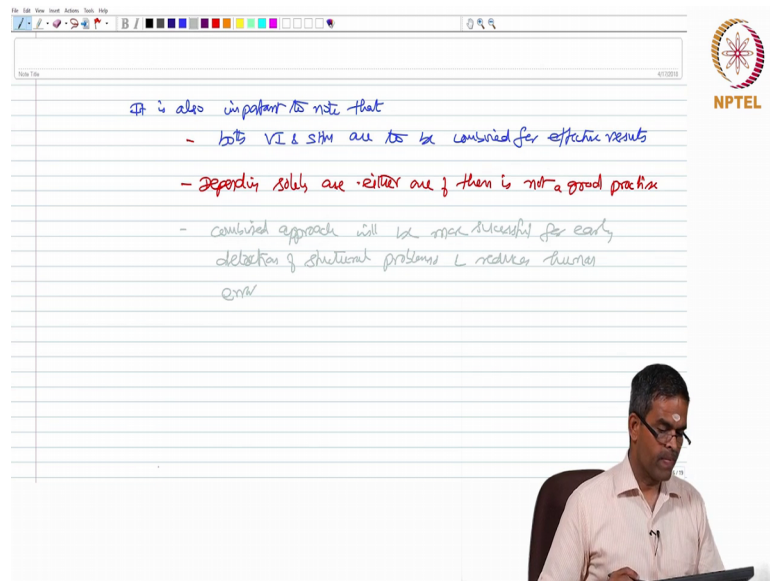
- It is done periodically as @ scheduled intervals
- These inspection intervals are well planned and become a part of maintenance of the IT system
- VI are contractual
 - It does not demand any additional training/knowledge towards civionics for the user
 - VI methods are done by expert third party

But in general user resistance is vital to successfully implement & execute SHM on the structures

On the other hand, if a compare visual inspection method, it is actually done periodically or at schedule intervals. These periods of inspection intervals or well planned and becomes a part of the technical maintenance of the structural system. More or less visual inspection are contractual.

It means it does not demand any additional training or knowledge towards civionics for the user because usually visual inspection methods are done by expert third party. But in general, user resistance is vital and important to successfully implement and execute SHM on the structures. So, one cannot ignore; similarly, the user resistance in case of any one of the methods.

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The screenshot shows a digital whiteboard interface with a toolbar at the top and the NPTEL logo on the right. The whiteboard contains the following handwritten text:

It is also important to note that

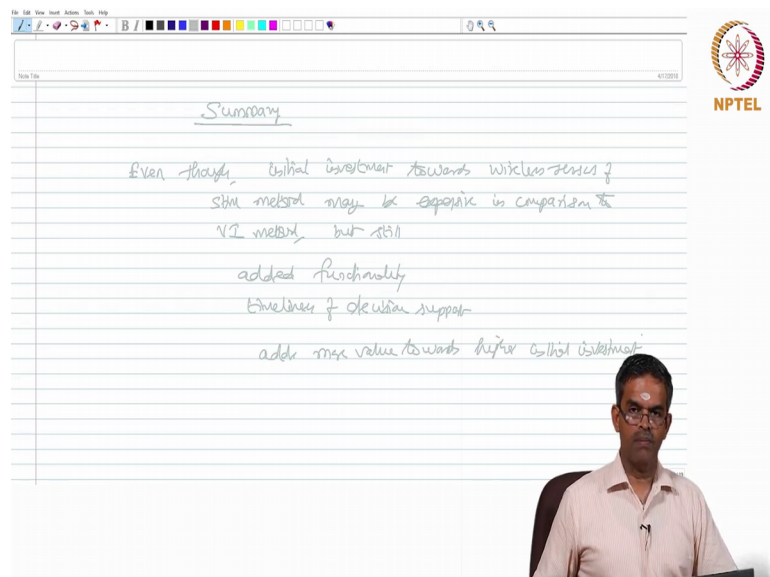
- both VI & SHM are to be combined for effective results
- depending solely on either one of them is not a good practice
- combined approach will be more successful for early detection of structural problems & reduces human error

Q.M.

In the bottom right corner, a man wearing glasses and a light-colored shirt is visible, sitting at a desk and looking towards the whiteboard.

Further, it is also important to note both visual inspection and SHM methods are to be combined for effective results. Depending solely on one on either one of them is not good; it is not a good practice. Combined approach will be more successful for early detection of structural problems and reduces human error.

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The screenshot shows a digital whiteboard interface with a toolbar at the top and the NPTEL logo on the right. The whiteboard contains the following handwritten text:

Summary

Even though, initial investment towards wireless sensors of SHM method may be expensive in comparison to VI method, but still

- address functionality
- timeliness of detection support
- add more value towards higher initial investment

In the bottom right corner, the same man from the previous slide is visible, sitting at a desk and looking towards the whiteboard.

Further as a summary, let us have the statement even though; initial investment towards wireless sensors of SHM method may be expensive in comparison to visual inspection

method. But still, added functionality and timeliness of decision support, adds more value towards higher initial investment.

So, that is the final statement we have in comparison between visual inspection methods and conventional structural health monitoring methods used for damage identification in structures.

Thank you very much and bye.