Note Title 3/27/2018

Module 1 - Lecture 02

SHM

- Necessity of SHM

preventive maintenance

- ensures safety
- functional/utility value
- establishes dependency on the system when it is demanded

- monitor
- Assess
  - we can advise control

to ensure performance of the system @ the present condition

Necessity for SHM

Infrastructure investment – is always not towards new construction
- need to be maintained
- slack-dam time - during which maintenance may become important
  - Economic constraints
- Major investment can be focussed toward maintenance of (old) existing structures
  - that have reached critical age
    - 30-40yrs + service life
  - These need to be inspected (periodically) and maintained appropriately

A 'BOOST' in the 'repair and retrofit' segment is the near future

- construction Industry should be prepared with
  - method
  - strategies to carry out repair
  - technological skills

All the above are possible, only when STM - is in existence

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"DISASTER PREVENTION"

Recent earthquakes, Tsunami's & cyclones

- demonstrated vulnerabilities of buildings

(1) coastal structures

nuclear reactors (Japan)

under the unexpected Environmental forces

- Not only lead to loss of life

(2) but also challenges the Economic sustainability of the nation

(3) knowledge update

STRM ← maintain performance { - Recent earthquakes - failure scenario - design procedures and ductile details are enforced through design codes

How SHM is vital for offshore structures ?

(1) - recent past - unmanned
- self-operating / self-producing || monitoring is very vital

(2) marine systems, (coastal jetties etc)
- should not be frequently intervened for repair
  - This could affect the functional value of the system
- require/demand a preventive maintenance while the system remains functional
  - structural repairs should be carried out with shut-down of the systems

(3) Most importantly
these structures need to be repaired, when they are loaded (Cannot offload the system)

To understand response behavior under such loading conditions

- a continuous monitoring

What is the scientific justification of SHM?

(1) Developed/modern world depends on complex and exhaustive systems of infrastructure

(2) many structures — around the world — were constructed during the economic progress in the recent past

- all of them are now 'aged'
- Canada, > 40% of the bridges are critically aged (> 50 yr old)

- public funds available are generaly too less towards replacement of the structure
  - repair/partial of the structure
    Justification of the partial repair (SHM)
- Using effective approaches, even regular/periodic maintenance can also be planned effectively
  - Effective planning of maintenance — continuous monitoring of the condition (SHM)

SHM — is a scientific approach involving capability to understand the importance of successful maintenance of (civil) infrastructure.

- SHM also involves use of various automated tools & systems
  - to improve the inspection procedures
  - technique repair (Gunite)
- can improve - Safety standards of public life
  - reduce risks
  - enable to discover new methods of reducing cost of repair & rehabilitation

List of major advantages of STM

(1) STM practices - ensures improvement in public safety

(2) - ensure effective utilization of public funding towards maintenance of civil infrastructure

(3) replacement of pipes (water supply lines) which had severe metallic corrosion
- enhances public life quality

(4) ensures use of new tools & technologies to carry out & maintain serviceability of structure
- declare them as good safe unsafe

- In case of ageing structures
  - SHM is advantageous
    - health can be monitored using
      - sensors
      - data collection & analysis
      - to initiate preventive maintenance
- Continuous monitoring and analysis of the recorded data
  - helps to update design procedures
    - avoiding flaws in the design
  - knowledge update on the design of structures

(1) — Increased Safety

(2) Detects Early risk

- SHM can be deployed to detect a poor structure (condition) and therefore its usage can be limited
  - enhances public safety
- SHM - useful tool - in prevent water and flood damages. caused by failure of dams and large reservoirs
  - Built-in sensors - are used to monitor change in water level
    - detect minor leaks & major failure.

- SDM as new design tool is used for design of foundations for bridges, pavements etc

- To a reasonable extent,
  - ground movement can be monitored
  - predict earthquakes
    - ↑ the preparedness of structures under the earthquake engineering
    - Landslides etc

(3) Longer life span

- preventive & periodic maintenance enhance the service life of the civil structural systems
- continues monitoring & plan for prevention & repair procedures
- It accounts for human error, if made
- SHM can also ↑ the existing design methods by eliminating the flaws in the procedures.
- Immediate safety in public buildings

(4) ↑ cost efficiency ✓

- It can be helpful to effective use utilization of public funding towards maintenance
- It can avoid unwanted maintenance of good health
  - a unnecessary periodic maintenance of a system, already in good health can be avoided
- It avoids shut-down operations ↑ Economic ηf of the system
  → RoI of CAPEx - oil & gas industry

Major advantages of SHM

(1) Reduces cost related to inspection

(2) mitigate impact of structural disasters caused by nature

(3) reduces need for immediate repairs

(4) ↑ public safety ↑ overall

(5) ↑ cost efficiency of public funds - reasonable manner

Summary

- Necessity of SHM
- Exclusive adv SHM have on public structures
- Int adv SHM can leap forward

SHM — ensure ↑ public safety

- reduce risk against disasters caused by structural failure under unexpected load