

Module 1

Lecture 5: Advantages of SHM

✓ SHM poses several challenges

- 1) foremost challenge is optimal definition of sensors in terms of its choice, type, layout and # of sensors to be deployed
- 2) communication system
 - wired vs wireless
 - R/F com other mode of transmission

Salient advantages of STM scheme

- (1) STM enables to update integrity of the structure
 - if monitoring is done on a continuous basis
 - (2) Utility or functional value of the structure is enhanced
 - It is put to its optimal use
 - (3) Minimizes the down-time
 - preventive maintenance can be planned ahead based on monitoring & assessment of the structure
- very helpful in Naval defence Systems

(4) Public safety is enhanced

for example, if STM is deployed on a bridge, and monitored continuously, then

its functional ability is predicted
as assessed to a higher accuracy to
avoid any catastrophic failure

(5) There is a significant improvement in maintenance organization of public structures

- unnecessary maintenance schedule can be avoided
- critical elements that require immediate attention are not ignored
- enables to carry out periodic maintenance with performance-based focus

- reduces investment on maintenance labour
 - Inspection labour is expensive
is too special/technical
is civil- community
- reduces human involvement towards inspection
- planning/ decision making on maintenance schedule
- Maintenance is planned/scheduled based on structural condition, Automatically

Unsatisfactory maintenance has many critical disadvantages

- (1) consequence, that arise from unsatisfactory
eg improper maintenance cause further
disaster

Example

(1) accident of Alsha Airlines

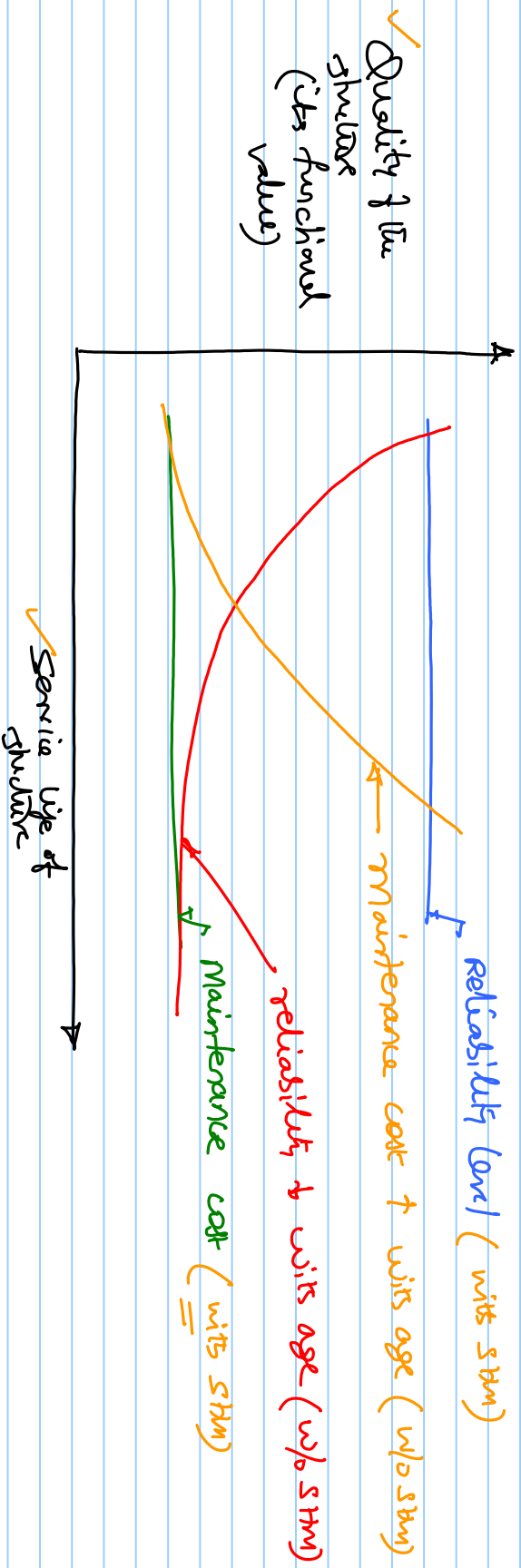
(2) collapse of the Mianus river bridge

- (2) Efficient use of funds towards maintenance is
reduced

- (3) Time / schedule of maintenance period can result
is down-time of the facility @ the critical need

Ex: dockyards

Comparison of structures with and without STM
in terms of its reliability



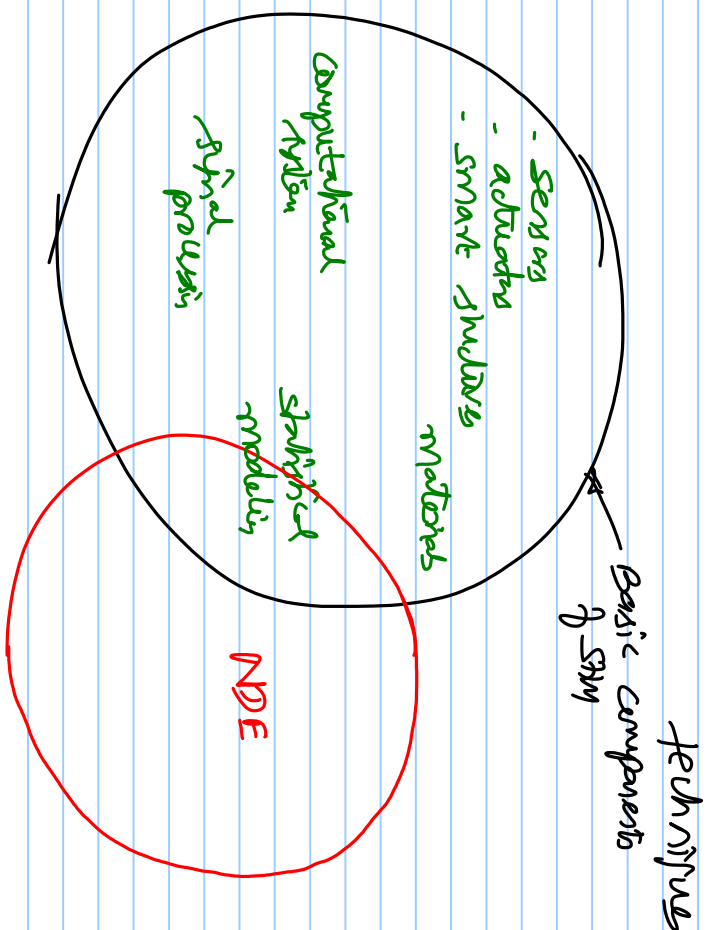
Structures with STM deployment

show max can be a constant maintenance cost, even with \uparrow in service life (aging)

- It also shows a constant reliability level indicating assurance of acceptable quality of the structure, its term of functional value

without STM \uparrow in maintenance cost with aging
 \downarrow in reliability with aging

Successful deployment of stm using various Non-destructive Evaluation (NDE)



NDE is a vital component, integrally connected to structural health monitoring

NDE techniques - recently deployed - very useful

I HELP hybrid Echo-Magnetic Performance Layer

This method is an alternate to a fully-integrated Echo-magnetic technique, which is quite expensive

- By embedding the Network of conductors in the material (on

bonding the network of conductors on the internal surface of the structure results monitoring is carried out

In this process,

- a grid which is a dense magnetic field is created

- This field is created by an external electro-magnetic antenna which comes via shielders

- This is made of conductive composite

(ex: epoxy composite carbon composites etc)

II Ultrasonic Vibro Thermography

- Lamb waves are used to generate ultrasound
- The embedded piezoelectric patch, with a help of camera monitors the surface thermal field
 - This field is produced by interaction of Lamb waves with the structure having defect (crack, fissure, delamination etc)
- This is very helpful to study delamination in composite

III lock-in shearographic imaging of ultrasound

shearographic imaging is created/generated by piezoelectric path, which is embedded on the surface of the structure

Classification of SHM methods
classification depends on the techniques used for damage detection

There are (4) levels of damage identification (Rytter, 1993)

Rytter A. 1993. Vibration-based inspection of civil engineering structures, Aalborg, Denmark

- Level 1 determination of damage is the structure
- Level 2 " of geometric location of the damage
- Level 3 quantification of severity of damage
- Level 4 prediction of remaining service life of the structure

Summary

- critical issues of deploying STM process
- salient/exclusive advantages of using STM scheme
- components of STM — Embedded/integrated with NDE tech
- Advanced NDE methods
 - monitoring health of components
 - mechanical systems
- loads of damage — STM classification

