Module 2

Lecture 4 : SHM planning and Management

Damage detection (or identification) is very vital for health monitoring

four levels of damage detection, commonly practiced in SHM

Level 1 : Determination of presence of damage

Level 2 : Determination of location of damage

Level 3 : Quantification of severity of damage

Level 4 : Prediction the remaining service life of the st

Global methods which can be used to detect damages

(ISIS)

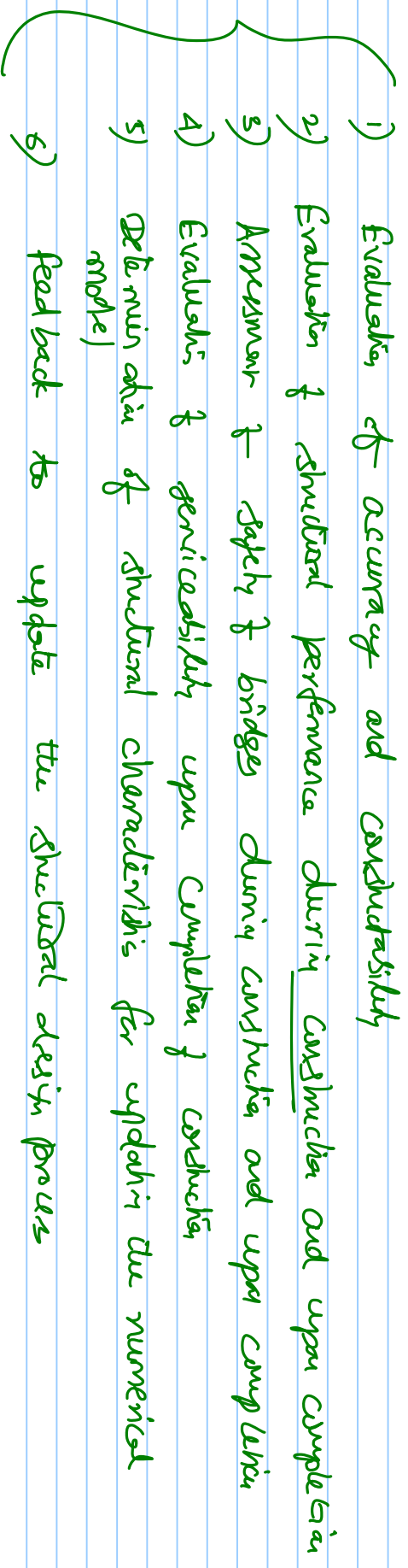ISIS Canada Research Group - which has developed Guidelines
       for SHM.

  – Guidelines for use of fiber ophi senses

  – wirelas remote sensing

  – Civionics (Electronics is civil engg application)

  – innovative Structure

  – reliability method

Damage
detection

(1) Natural frequency method

(2) Mode shape and operational frequency method

(3) Modal strain energy method

(4) Residual force vector method

(5) Model updating method

(6) frequency-response function

(7) statistical method

In Vibration monitoring to estimate damage, what are its

__Specific objectives?__

— As per ISO (2002)

1) Evaluation of accuracy and constructability

2) Evaluation of structural performance during construction and upon completion

3) Assessment of safety of bridges during construction and upon completion

4) Evaluation of serviceability upon completion of construction

5) Determination of structural characteristics for updating the numerical model)

6) Feed back to update the structural design process

Structural Assessment algorithm for SHM & Civil Engg Structures

Maintenance of infrastructure depends on several factors

1) importance of the structure itself
2) Maintenance cost
3) New demand, occurred in the structure due to additional loads, if any

In Normal structures, when they are affected by loads, degradation of material,
(or) accidents, Structure may lose its functionality

Two types of events can trigger an inspection of civil Engg structure

1) periodic inspection, determined based on a maintenance strategy,

2) Invited inspection (I^2), which will be triggered by any external event

The external event can be

i) alarm, raised by the public

ii) observing any damage

ii) overloading of a bridge

NHAI

(ii) observation of toll-booths operation & correction of anything

Monitoring data & civil infrastructure involves

___inspection___

where the main objective is to
diagnose the structure, its support
condition & further to recommend
(a) Advice the decision makers in
choosing one of the following option

√ (1)   Build a new structure, in place of the existing one
         -   request of severe damage that has occurring
             is to stay
         -   ↓ performance level to a very
             low Index

(2) Retrofitted use of the existing structure,
in case that is less-significant damage

    — In such cases — traffic loads can be restrictory
                — type of vehicles can be restricted
                — speed of the vehicles can be restricted

(3) Strengthening the existing one to increase (or enhance) the
performance level of the structure

(4) Recommending a continuous monitoring in case the
performance of the existing one does not meet
the desired safety requirements under extreme loads
(flood, earthquake, hurricane etc)

(5) It can also suggest development of an Alarm System, integrated with the scheme so that safety of the public is enhanced

Factors / activities that constitute planning of SITY in civil infrastructures

- Establish objectives of stm inspection

  - Should focus on planning analysis operation & Evaluation the complete data of stm inspection process

  - During the operation phase of stm scheme, one should also check a typical outcome of the process and its accuracy so that benefits of stm are not over estimated

- It should be within the budget of the stm system

- cost should include planning bill the control stage

(2) Establishing a convenient budget for carrying out stny

    — cost & stny should include control strategies as well

    — cost should also include any buffer system which is planned as a standby

(3) Choosing appropriate analysis tools

    — should be chosen such that they are capable of identifying the parameter, which are to be monitored & computed

- Extraneous interpolation of data of the parameters should be avoided.

- If the structure is under static load, then there is no need to perform complicated dynamic analysis

4) Design / developing a suitable sensor system layout

- Monitoring system should be carefully designed

- It must contain all vital parts of structure scheme

- one has to decide whether local(s) global monitoring, long-term (s) short-term monitoring periodical(s) triggered monitoring - need to be finalized

(5) Design of topography of the sensor system.
acquisition & communication system

- Sensor system, should fulfil the strategic monitoring

for, it a long-term monitoring is suggested
then sensors should be robust & should
be capable of giving reliable results
over a long period of time

- Given the sensors to the surface of the structure
the strain gauges is not advisable
is cost of long-term monitoring
because sensors/glue will be affected
by humidity, temp, UV light etc

- To decide the desired location, layout and scalability

- Should be planned in such a manner that the are scalable & re-arrangeing according to a new set of command control

- Layout should be well-do unwanted to execute in complexity

(6) - Design & acquisition & storage system

- Acquisition system controls the overall execution of SDM proven. Hence should be carefully designed

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- All equipments, required to collect the data, interpret from the data is physical being, should be planned and well documented

- Sufficient back-up scheme of equipments/persons so that in case of any breakdown, they maintain is data continuity

(T) Design of Communication system

- Should be planned such that no packets of information (data) is lost in communication

- when the system triggers an alarm, then backup system is necessary, to maintain the safety even the system is collapsing

(8) Design & Evaluation method of slm

- Evaluation system is designed to be compatible with the monitoring operation

- It should be easy to handle

- It should be capable of handling / tracking the pattern recognition behaviour

  pattern-recognition is faster & effective to assess the condition of the structure

Summary

— Damage identification / detection loves

— planning guidelines is SHM process to be
   done for civil infrastructure