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STRUCTURAL HEALTH MONITERING AND ITS REMEDIES

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ABSTRACT
Over the last 50 years, a number of catastrophic bridge failures have called attention to the disrepair of national infrastructure systems and the need for structural health monitoring. For example, the I-35W Bridge in Minneapolis, Minnesota, catastrophically failed on August 1, 2007 without warning. In recent years, the bridge was rated as "structurally deficient" after annual inspections revealed corrosion, poor welding details, fatigue cracking in steel members and dysfunctional bearings considering the catastrophe of the I-35W Mississippi River. While no conclusions can yet be drawn as to the cause of the bridge's catastrophic failure. it is critical to implement a system to monitor the health of bridges and report when and where maintenance operations are needed. Therefore, it is important to have a systematic approach to monitor the health of a bridge. In spite of its promising benefits, structural health monitoring (SHM) is infrequently used in bridge applications. Bridge Structural Health Monitoring (SHM) has rapidly become one of the main interests in civil engineering field. Inexpensive and efficient SHM method utilizing.

KEYWORDS: Structural health monitoring,remote sensor,provide remedies

INTRODUCTION
Structural health monitoring has attracted much attention in both research and development in recent years. This reflects continuous deterioration conditions of important civil infrastructures, especially long-span bridges. Among them, many were built in the 1950s with a 40- to- 50-year designed life span. The collapses and failures of these deficient structures cause increasing concern about structural integrity, durability and reliability, i.e. the health of a structure throughout the world. Currently, there are no foot proof measures for structural safety. A structure is tested for deteriorations and damages only after signs that result from fault accumulations are severe and obvious enough. When the necessity of such tests becomes obvious, damages have already exacerbated the system's reliability in many cases and some structures are even on the verge of collapse.In general, a typical SHM system includes three major components: a sensor system, a data processing system (including data acquisition, transmission and storage), and a health evaluation system (including diagnostic algorithms and information management). The sensors utilized in SHM are required to monitor not only the structural status, for instance stress, displacement, acceleration etc., but also influential environmental parameters, such as wind speed, temperature and the quality o fits foundation. Since a large number of sensors will be involved in a health monitoring system, the acquisition, transmission and storage of a large quantity of data for such continuous monitoring is a challenging task.

LITERATURE REVIEW

Michael Fraser[et al] (2004)A bridge monitoring TestBed is developed as a research environment for sensor networks and related decision-support technologies.

Hong-NanLi[et al] (2004) This paper presents an overview of current research and development in the field of structural health monitoring with Civil Engineering applications.Specifically, this paper reviews fibre optical sensor health monitoring in various key civil structuresincluding buildings, piles, bridges, pipelines, tunnels, and dams.
Ka-VengYuena(2005)A Bayesian probabilistic approach is presented for smart structures monitoring (damage detection) based on the pattern matching approach utilizing dynamic data. Artificial neural networks (ANNs) are

employed as tools for matching the “damage patterns” for the purpose of detecting damage locations and estimating their severity.

METHODOLGY

Vibration Types

There are three type of vibration explained below

Free vibrations

Excitation forces used during ambient vibration tests are in their nature immeasurable. As a consequence themethods of data analysis developed typically for forced vibration tests and based upon Frequency ResponseFunctions (FRF) have to be used with modifications. Instead of FRF matrix the Cross Spectrum Matrix is used toperform modal properties estimation and as a result unscaled mode shapes or operational deflection shapes are obtained together with natural frequencies and damping factors

Forced vibrations

Experimental modal analysis applied to bridge structure requires an appropriate excitation method to make allinvestigated modes observable. Heavy and stiff structures such as reinforced concrete bridges, with high dampingare often difficult to properly excite either by normal traffic or even by special heavy trucks. Engineers involved inbridge testing since 70’ of the last century have used special exciters for this purpose. The exciters are based onvarious principles of work and they generate the exciting force in different ranges of frequency. Some of them arebased on principle of an unbalanced rotational mass and generate vertical or horizontal force with amplitudegrowing exponentially with excitation frequency. There are also devices which produce single impulses or a seriesof impulses with controlled frequency of repetition as well as the electro-dynamic shakers producing various types of exciting signal (sine, random, quasi-random etc.).

Ambient Vibrations

Free vibration tests are widely used in bridge monitoring due to fact of simple inducing vibration by a singleimpulse produced by impact hammer, dropping weight, suddenly releasing applied deflection etc. This method isespecially effective in application to flexible structures with low damping when the usable signal can be acquiredfor long time what means the higher resolution in frequency domain. Free vibration test has the same advantagesas forced test and its results can be processed in a similar way when the impulse force is measured. Thedifference is only in repeatability of the excitation. One of the most important sources of scatter in results of freevibration test is the way of excitation force application (e.g. deviation from the axis perpendicular to the hit surfacein test with the impact hammer). The second issue can be the signal to noise ratio. On one hand excitation of alarge structure by force impulse is difficult for the sake of so called crest effect and on the other hand the ambientnoise at the site is sometimes too high (e.g. a bridge over deep valley with strong wind, neighborhood of busy street or railway line etc.) to perform the test with properly induced vibrations. The first obstacle can be avoided byusage of excitation in form of releasing the applied deflection what can have more energy than the force impulseand it doesn’t cause local damages. Applications of stochastic methods of data processing and modal properties identification with white noise modeling can solve the second problem.

Strain Measurement

Strain can be measured by a diverse array of sensors. Two types commonly used for civil engineering applications are Foil Strain gauge and Vibrating wire strain gauges.

Foil Strain gauge

Foil strain gauges have been widely used for strain measurement in experimental stress analysis. However, they are less attractive for field SHM of bridges especially when the distance between the gauge and the readout unit increases. This is due to the fact that the low-level voltage signal produced by the foil strain gauge is susceptible to electromagnetic and electrostatic interference from external sources. When unconditioned signals from foil gauges are transmitted a relatively long distance, the electrical noise superimposed by the electromagnetic and electrostatic fields becomes significant and can lead to inaccurate results and incorrect interpretation of the strain signals. The problem is more severe for dynamic measurements, since filtering the noise can change the characteristic of the original signal.

Information of Bridge Used For study purpose

1. Name of bridge: Kukadi river bridge(Ozar Bridge)
2. Location of bridge:NarayanaononOturroad, Pune
3. Length of bridge: 107m
4. Type of bridge: RCC
5. Study of part: beam, Pier
6. Short span: 21.4m
7. Pier: 4
8. Work started date:9/2/1977
9. Work completed date: 9/2/1979
10. Age of bridge: 37 yrs.
11. Test conducted on Pier: Rebound hammer
12. Test to be conducted on bridge: Remote Sensor Testing using Vibration sensor

Fig. 1 Kukadi RiverBridge at Ozar

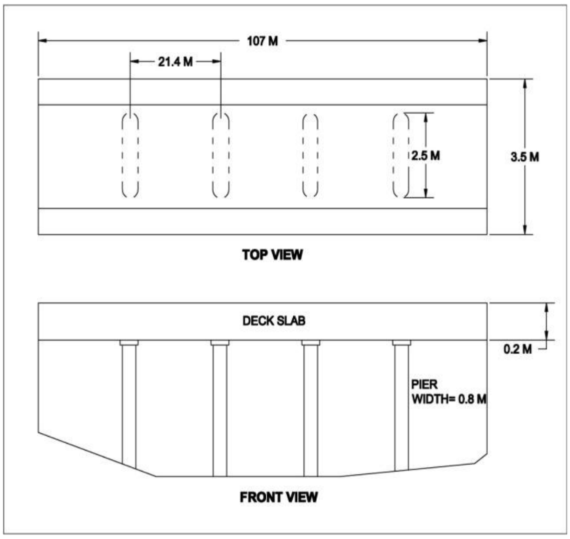

Fig. 2 Cad drawing of Kukadi RiverBridge at Ozar

CONCLUSION

Structural health monitoring has attracted much attention in both research and development in recent years. This reflects continuous deterioration conditions of important civil infrastructures, especially long-span bridges. Among them, many were built in the 1950s with a 40- to- 50-year designed life span. The collapses and failures of these deficient structures cause increasing concern about structural integrity, durability and reliability, i.e. the health of a structure throughout the world. Currently, there are no foot proof measures for structural safety. A structure is tested for deteriorations and damages only after signs that result from fault accumulations are severe and obvious enough. When the necessity of such tests becomes obvious, damages have already exacerbated the system's reliability in many cases and some structures are even on the verge of collapse.

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