PalArch's Journal of Archaeology of Egypt / Egyptology

# AN OVERVIEW OF STRUCTURAL HEALTH MONITORING BY USING SMART SENSING TECHNOLOGY – "A REVIEW"

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**Ashokkumar Palanisamy, Dr.D.Jegatheeswaran and Saranya Sampath: An Overview of Structural Health Monitoring by using Smart sensing Technology – "A REVIEW"--Palarch's Journal Of Archaeology Of Egypt/Egyptology 17(6). ISSN 1567-214x**

Keywords: Piezoelectric sensor, Smart aggregate, Wireless sensor, Smart material, Transducers, Optic fibre sensor and Ultrasonic sensor

## ABSTRACT

In the present growing technology, the continuous monitoring of structures has been easier task by using the various sensor techniques and Internet of Things technology to ensure the safety and strength of the structures. All the structures will get degrade and deteriorate with increase in time due to loadings, corrosion and other factors. To implement the continuous monitoring system for the structures, the Sensors are plays major role for the monitoring process. Due to various continuous environment and climatic changes, the strength and durability of the structures are severely affected and the damage deduction inside the concrete structure is becomes a very monotonous process. The various non destructive testing methods were used to find the strength, damage and durability assessment in the existing and proposed concrete structures. In the destructive testing methods, the assessment is carried out near by the concrete damaged structures by direct contact which may cause adverse effect. By using modern technology, nowadays non destructive and non contact methods have been implementing to deduct the various parameters of the concrete structures by using modern sensors. This review paper gives the overview about the sensors and explains the various practical applications of sensors in the concrete structures to identify the problems by using modern sensors like piezoelectric sensor, Wireless sensor, and smart aggregate to deduct the concrete strength, rate of corrosion, cracks, and strain deflection of the structures

## Introduction

In view of detecting damage and evaluating the strength for engineering structures, structural health monitoring stands behind. In this, damage of structure is defined as changes to the material and the geometric properties of a structural system. It also includes changes to the boundary conditions and system connectivity these things which adversely affect the system's performance. The structural health monitoring involves in the process of collection of data in a time for periodical dynamic measurements and statistical to determine the current state of system health. Up gradation of information, regarding to the quality of structure should be periodically monitored for ensuring the strength. After many great occurrence, like natural disasters and unanticipated sudden earthquakes or man-made activities like bomb blasting structural health monitoring is used for rapid condition and authentic information about the probity of the structure.

Importance of Structural Health Monitoring

SHM paves a trending way in Civil Engineering field. The health monitoring and maintenance of the concrete structures that mark some modern society has long been considered to be crucial one. This emerging trend has several benefits from providing a safety standard and reducing the risks from sudden response of the structure and it also discovers new opportunities to reduce costs. Structural health monitoring which increases public safety helps to detect safety risks, preventing water and flood damage caused by failed dams and to reduce unnecessary maintenance on structural components that are still in the good condition.

Smart Material

A smart material refers to the material that has some property that can be altered through the application of an external stimulus. A smart sensor is a device, which decodes sound, heat, motion etc.., The functions are execute by microprocessors and any other devices which mixes with sensor and a microprocessor is known as Smart sensor. The processor must be the part of physical unit for the good sensors. The sensor will not function only to deduct and signals. It will also used to perform some other actions. Sensor gives a digital signal as well as it reads analog values and it can also transfer the signal and execute the logical functions and command instructions. Smart sensors will provide tremendous opportunity for development of the next generation and for research and development.

Piezoceramic Transducers

To monitor the health of the concrete by using amplitude recoded wave signals, the embedded smart aggregate and the combination of piezoceramic patch are considered as the effective tool. A damage index expression will shows the performance of the damage in a quantitative manner. Piezoelectric transducers are used at various environmental temperatures in the concrete structures for health monitoring. The signal amplitude increases with temperature, and the low temperature (30 C- 50 C) have less influence on the monitoring signals compared with that of high temperatures (60 C-80 C) [1]. To charter the concrete health, the underlying PZT-structure electromechanical interactivity for impedance-based health is used. This strategy proposed is electromechanical

impedance (EMI) procedure, which includes a streamlined exact technique to analyze basic wellbeing utilizing installed self-detecting that under piezo impedance transducers. The piezoelectric transducer in one brilliant detecting total will utilize actuator to send excitation waves. The piezoelectric transducer in the other shrewd detecting totals is utilized as a sensor. The presence of break or harm inside the concrete structure will go about as a pressure alleviation in the wave spread way To carry out the test, a function generator is used to make the SSA as and actuator and an Oscilloscope is required to capture the signals received by the sensor. The smart sensing aggregates will use as both actuator and sensor [2]. For the different designing frameworks, piezoelectric fired Lead Zirconate Titanate (PZT) based electro-mechanical impedance (EMI) strategy has been effectively. In the conventional EMI strategy, the PZT electro-mechanical (EM) permission (backwards of the impedance) is utilized as harm pointer, which is hard to determine the impact of harm on auxiliary properties. To screen the compressive strain of the concrete structure, the A sort of inserted piezo resistive concrete based strain sensors (PCSS) is utilized. A four-post course of action of installed cloth anode is utilized to dispose of the contact obstruction among cathodes and piezo resistive concrete based material in this manner improving the estimating precision of the yield sign of PCSS. The PCSS can be utilized to ceaseless screen of compressive strain in the concrete **[3].** The interface between the concrete and steel in strengthened concrete assumes a fundamental job and it oversees the communication between the materials under stacking. At the point when the interface is genuinely harmed, with the end goal that a full scale break is shaped, debonding may happen or huge slip may happen, and the heap moving limit of the interface would drop drastically. To determine the delamanition between the concrete and steel, the piezoelectric segments are embedded on strengthening bars in the RC structures as sensors and actuators to create the signal [4]

Ultrasonic Sensor

The Corrosion Monitoring and Evaluation of Reinforced Concrete Structures can be indentifying by using the Ultrasonic Guided Wave Technique. By utilizing fiber bragg grinding (FBG) sensor, the constant checking and early admonition framework are utilized in the retrofitting process. By consistent observing the information, it gives the early alerts and reference for investigation the strength of the structure continuously. The ongoing observing is a part of building security giving wellbeing and limiting death toll under retrofit condition [5].

Smart Aggregate

The smart sensor is the one of the special type of sensing aggregate which is small cylinders attached with piezoelectric patches inside. It tends to be inserted in concrete structures for checking and it utilized as the two actuators and sensors. It is widely used to evaluate the effectiveness defects in the concrete beams [6]. To screen the anxiety in the concrete, the concrete based pressure/strain sensor was created by utilizing the pressure/strain detecting properties of an attractive miniature wire implanted in concrete based composite (MMCC). It is a contact-less sort of

sensor utilized measures the varieties of attractive properties in the concrete which coming about because of pressure varieties. Sensors can be planned accomplish to monetary approach to screen concrete wellbeing. Flimsy attractive miniature wires are inserted in the center of a concrete based chamber, which the implanted MMCC sensor is fit for estimating inside compressive pressure around the scope of 1–30 [7].

Wireless Sensors

The modern sensing technology by the sensors is not widely applied in the Civil Engineering field because of wiring problems in the structures. To overcome the issue, the wireless smart sensor which is build with the wireless communication system and with microprocessors is easy to continue monitoring, control and maintenance. The design, construction and implement of smart sensors in the structure are one of the challenges to researchers. The remote savvy total based concrete crack detection (CCD) frameworks are utilized to approve the effectiveness of the proposed framework. In addition, the framework is "wire free" and force productive, that makes it appropriate for the unpredictable climate of a building site [8]. To transfer the Wireless power to the inserted smart sensor, near-field coupled loop antennas are used. It is found that the multi looped antenna designed with 10 MHZ can attain fairly great efficiency when it is matched and operated whether in free-space or within dry concrete. With the transmitted power of 5 watt1.9, 1.6 and 1.3 watt of power received by the sensor which is embedded in the concrete with 2, 4 and 6cm respectively.

Fibre Sensor

Two sorts of sensor assurance framework for fiber optic sensors (FOS) are inserted type and A surface-mountable sort with Extrinsic Fabry–Perot interferometric (EFPI) and fiber Bragg grinding (FBG) sensors which are created to screen the fix progress and basic wellbeing status of cement [9]**.** By using modern technology, a new concept of designing cable sensors has been proposed for health monitoring of civil infrastructure. The concept has been developed based on the change in topology of the outer conductor of a coaxial cable sensor. The other sensor has been proposed dependent on the triboluminescence wonder for distinguishing and checking harm in aviation and civil infrastructure systems (CIS), While huge work is being done in growing such frameworks for aviation structures, almost no work is being done in creating triboluminescence-based sensor frameworks for the basic and maturing CIS. A ZnS: Mn-based cementitious patch will emit light when the structure is loading or fractured [10].

Durability Assessment

The different auxiliary wellbeing checking strategies and methods are accessible for surveying the applied burdens, relocations, consumption, stresses, and strains in a concrete structure The new inventive procedure is created to detect the material and wellbeing observing framework which is intended to quantify different material properties that are fundamental for assessment of the concreteness execution of the strengthened concrete structure. In this system, temperature sensor and electrical conductivity based sensor are developed to determine the rate of hydration and strength

of the concrete structures [11]. In the reinforced concrete structures, Corrosion can affect the durability and integrity of the structures.. The capacitor sensors are used to monitor corrosion potential of reinforcement in concrete.

## Conclusion

The structural health monitoring is about to deducting the defects of concrete and strength by using the fibre optic and piezoelectric sensors. In other studies it reveals that, the sensors are specially developed based on the requirement with micro wires and piezoelectric batches. This review paper provided a brief introduction to smart sensing technology which is used to identify the number of parameters. There are various sensors are used in health monitoring to identify the structural properties by using fibre optic sensor, corrosion sensor ultra sonic and piezoelectric sensors which gives the real time solution. By using the modern technology, sensor are used for deducting various properties of concrete which was used to increase the efficiency, durability, damage and strength of the concrete structure through continuous monitoring process.

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