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Structural Health Monitoring on RCC Slab by Use of Piezoelectric Material

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Abstract - Piezoelectric lead zirconate titanate (PZT) is being gradually applied into practice as a new intelligent material for structural health monitoring. In order to study the damage detection properties of PZT on concrete slabs, simply supported reinforced concrete slabs with piezoelectric patches attached to their surfaces were chosen as the research objects and the Electromechanical Impedance method (EMI) was adopted for research. Healthy and damage condition were designed to test the impedance values at different frequency bands. Frequency band is 50Khz to 300Khz in step 200. Consistent graphs are found by admittance vs frequency. The root mean square deviation (RMSD) damage indices are capable of detecting the structural damage. The newly proposed damage index Ry/Rx can also predict the changes well. The numerical and experimental studies verify that the Electromechanical Impedance method can accurately predict changes in the amount of damage in reinforced concrete slabs. The damage index changes regularly with the distance of damages to the sensor. This relationship can be used to determine the damage location. The newly proposed damage index Ry/Rx is accurate in determining the damage location. The comparison between healthy and damage condition of slab specimen is plotted for both signature have been changed in healthy as well as damage condition. So, we analyze PZT work as a smart material (actuator and sensor) in surface bounded slab. In this way, the structural health monitoring has been done in RCC Slab.
Keywords—PZT , EMI ,RMSD , Structural Health Monitoring , Damage Index

I. INTRODUCTION

The Structural health monitoring (SHM) is a procedure in which certain method are implemented for determining the existence, location and severity of damages and remain life of structure after the occurrence of damage. This term is frequently referred to civil, aerospace and mechanical engineering transportation. It is the unanalyzedn location of the loading situation and the critical responses of a structural system or its mechanism. Health monitoring is normally used to track and estimate the performance, symptoms of operational incidents and discrepancy due to decline or damage as well as health during and after excessive events. Damage identification is basic objective of the SHM.

Smart materials can be either active or passive smart material are those material which possesses the ability to transform their geometric or material property under the application of electric ,thermal or magnetic field. There by acquiring on inherent capacity to transducer energy. Piezoelectric material are active smart material .Being active, they can be used as force transducers, PZT materials and actuators, which is convert into electric energy to force, they are also active transducers.

The smart material, which are not active are called passive smart material although smart these lack to inherent capability to transducer. Fibre optics is a good example of passive smart materials. Such materials can act as sensors but not as actuators or transducers.

II. BLOCK DIAGRAM

III. EXPERIMENTAL SET UP

Details of specimen: Firstly, the test, the force of two way simply supported slab was simulated .The size of reinforced concrete slab was 500 mm$\times 400\, mm \times 25\, mm$.The concrete grade was M 25 and the steel grade of Galvanized iron, and all edges are simply supported. The slab plate was divided diagonal and diagonal cut at this point Piezoelectric embedded to the centre of slab surface as shown. First the impendence curve of the undamaged concrete slab was tested/and different damage were set later, using the cutting tools. We cut the first damage track in the corner of the concrete slab as shown. After words the cut is enlarged and depend continually to the condition .then the second track of damage was cut at another location on the slab and all its condition are listed in table .The frequency bands are 50-300 KHz step of 200.

Figure -1: Experimental setup

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IV. DATA ANALYSIS

A. Testing of Slab

S.N	FREQUENCY (KHz)	Conductance of different Slabs at a particular frequency in (mho)		
		SLAB-1	SLAB-2	SLAB-3
1	50	0.0000571	0.0000528752	0.0000628542
2	80	0.00011	0.000102	0.000117
3	110	0.000183	0.00018	0.00021
4	140	0.000433	0.000344	0.000352
5	170	0.000778	0.000684	0.000546
6	200	0.00131	0.001973	0.001155
7	230	0.001991	0.003379	0.001912
8	260	0.002392	0.002786	0.002702
9	290	0.002307	0.00216	0.002211
10	300	0.0023333	0.001963	0.001995

Table: Computation of conductance at healthy stage

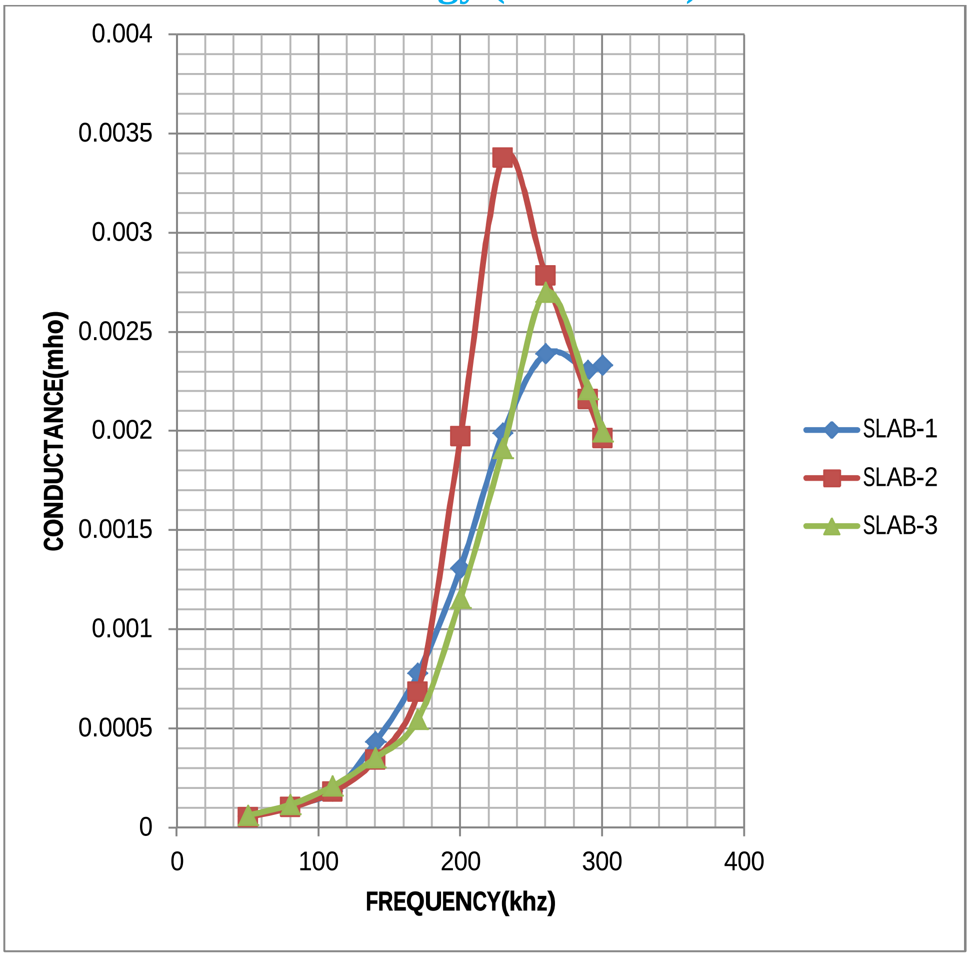


Figure: Graph of frequency vs. conductance at healthy stage

S.N.	FREQUENCY(KHz)	Conductance of different Slabs at a particular frequency in (mho)		
		SLAB-1	SLAB-2	SLAB-3
1	50	0.0000594	0.00005378	0.00006336
2	80	0.000116	0.000103	0.000119
3	110	0.000197	0.00181	0.000209
4	140	0.000442	0.00035	0.000355
5	170	0.0008	0.000759	0.000572
6	200	0.001274	0.002142	0.001269
7	230	0.002015	0.003227	0.0021
8	260	0.002486	0.002764	0.002457
9	290	0.002391	0.002144	0.002346
10	300	0.002211	0.00193	0.002

Table: Computation of conductance at damage stage

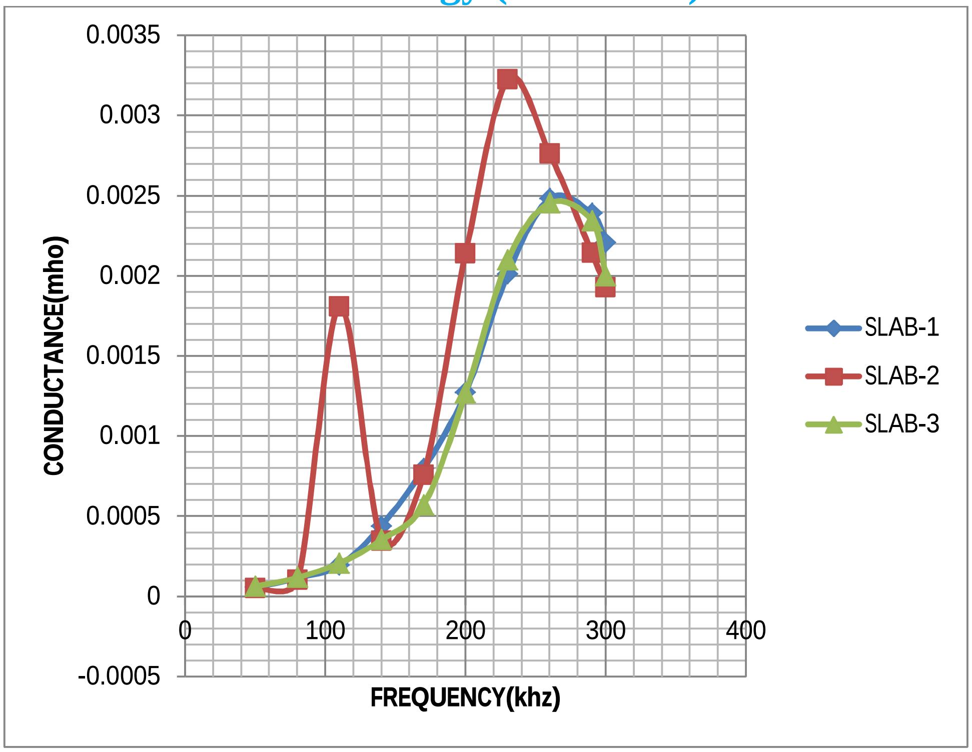
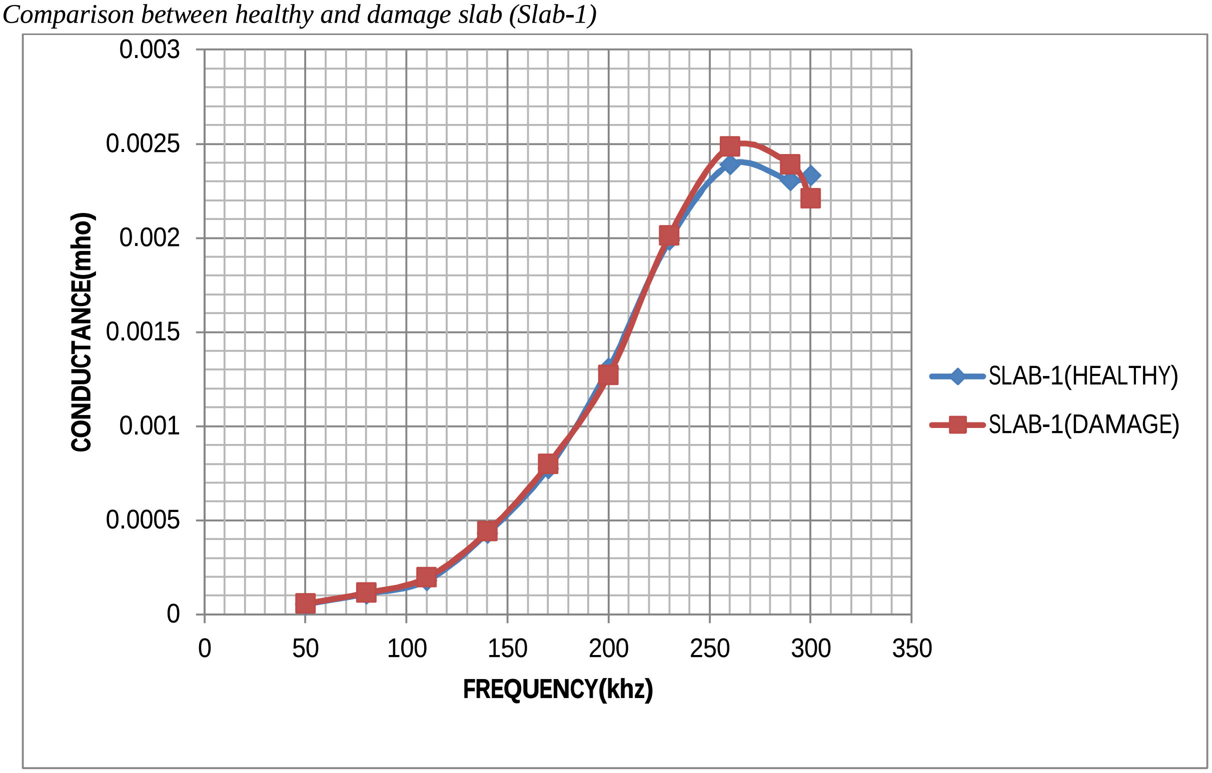


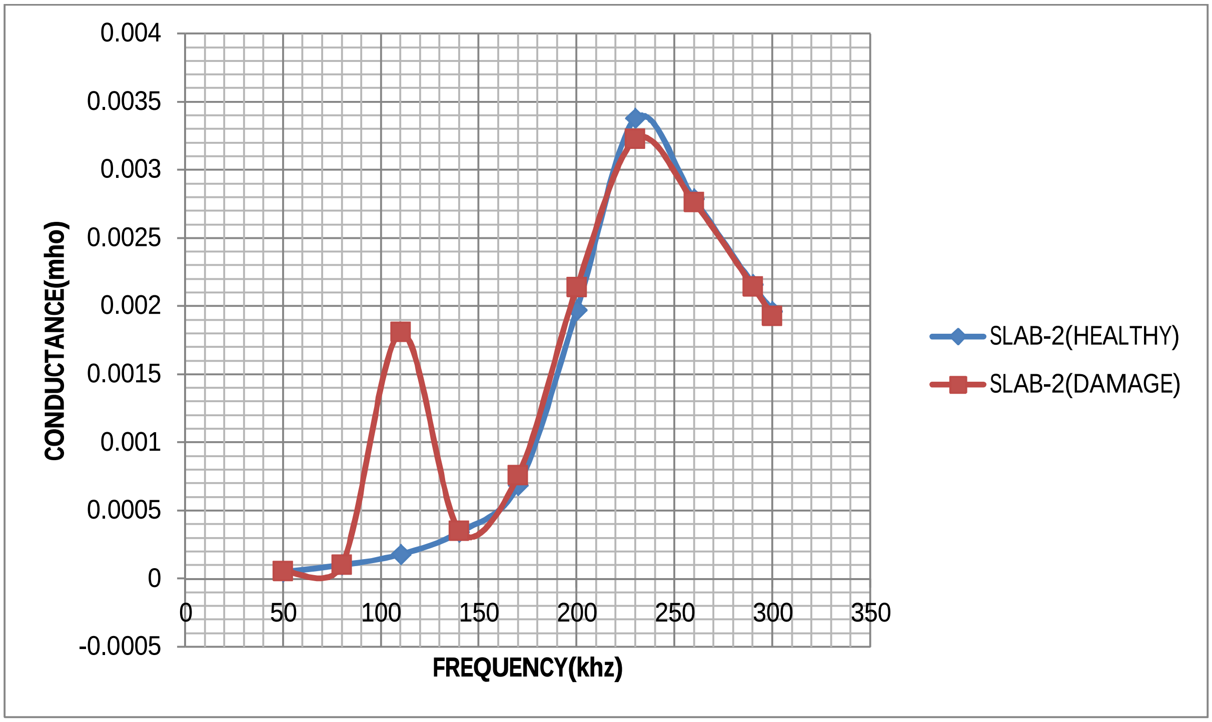
Figure: Graph of Frequency vs. Conductance at Damage Stage

V. RESULT AND DISCUSSION

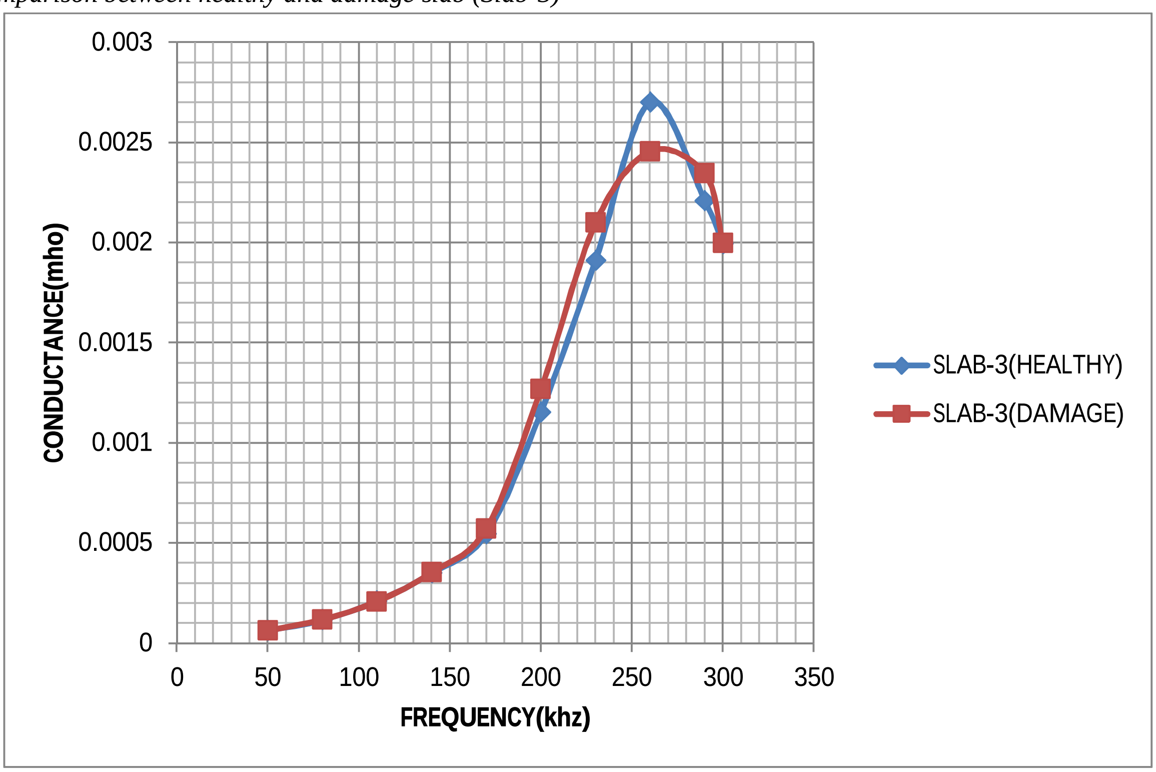
A. Comparison between healthy and damage slab (Slab-1)



B. Comparison between healthy and damage slab (Slab-2)



C. Comparison between healthy and damage slab (Slab-3)



VI. CONCLUSION & FUTURE SCOPE

In the analysis of the reinforced concrete slab, the real part of the impedance curve is used. The frequency range is 50-300 KHz in the step of 200. In this analysis, the curves of healthy and damaged conditions are showing different signature.

So in this way, we can conclude that PZT material can be used as a sensor in reinforced concrete slab as a smart material and may work like actuator and sensor. In this way structural health monitoring (SHM) can be done.

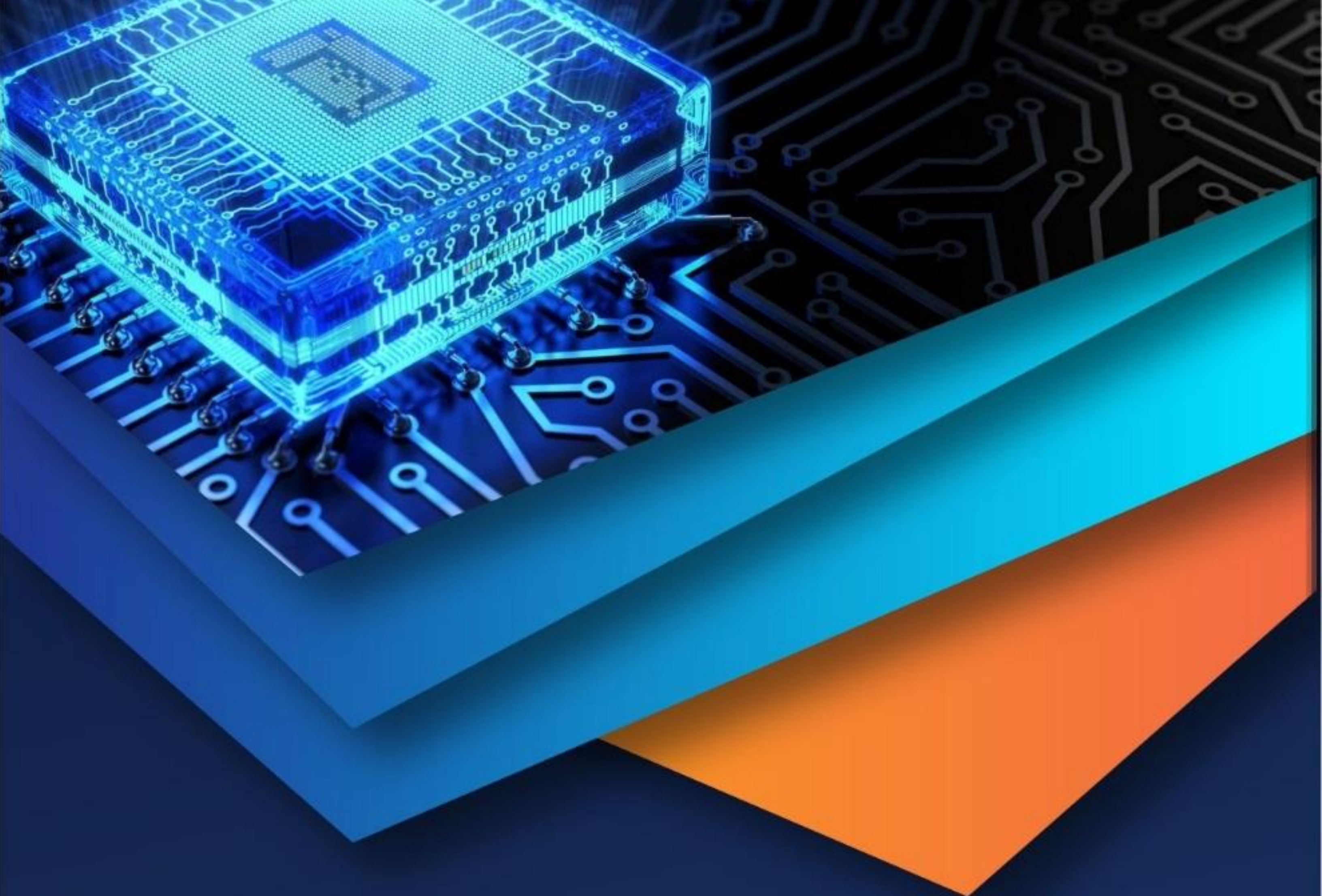
A. Future scope

Present research work can be further extended as follows:

1) A connection might be created between proportional stiffness and identical damping (recognized by PZT patch) and the real static firmness and damping of the structure individually.
2) In this exploration, the studies have been led on model structures. It is prescribed that the studies might be reached out to genuine structures, for example, structures and extensions. Long haul studies might be performed to evaluate the impacts of harm on the equal system parameters recognized by the PZT patch on account of genuine structures.
3) Future studies may concentrate on the hypothetical part of the proportional system parameters and their connection with material and geometry of the structure.
4) Future studies may likewise concentrate on the part of vitality collecting in order to make the path for self-propelled self-ruling sensors, with incorporated handling and remote transmission units.
5) Civil engineering require opportune analysis for the evaluation of their honesty and soundness for the future advantage of the human culture, life health and cost viability.
6) Their sheltered and prudent execution stands a high advantage for the general public, since it balances out budgetary administration and health.
7) In general, their execution contains large number of field in light of the fact that they are frequently subjected to traumatic common debacles and concentrated use.
8) To defeat these difficulties, numerous associations and autonomous exploration bodies thinks of new procedures for full scale execution evaluation and behavioural translation of structures, which is termed as basic structural health monitoring (SHM).

REFERENCES

[1] Bhalla, S.; Soh, C.K. Structural impedance based damage diagnosis by piezo-transducers. Earthqu. Eng. Struct. Dynam. 2003, 32, 1897–1916.
[2] Bhalla, S.; Soh, C.K. Structural Health Monitoring by Piezo-Impedance Transducers. I: Modeling.J. Aerosp. Eng. 2004, 17, 154–165.
[3] Lim, Y.Y.; Bhalla, S.; Soh, C.K. Structural identification and damage diagnosis using self-sensing piezo-impedance transducers. Smart. Mater. Struct. 2006, 15, 987–995.
[4] Yan, W.; Wang, J.; Chen, W.Q. Delamination assessment of a laminated composite beam using distributed piezoelectric sensor/actuator. Smart Mater. Struct. 2011, 20, 075011:1–075011:14.
[5] Xianyan Hu, Hongping Zhu, and Dansheng Wang, "A Study of Concrete Slab Damage Detection Based on the Electromechanical Impedance Method", Sensors 2014, 14, 19897-19909.
[6] Rama Shanker, "An integrated approach for Structural health monitoring".
[7] Wang, D.S.; Song, H.Y.; Zhu, H.P. Numerical and experimental studies on damage detection of aconcrete beam based on PZT admittances and correlation coefficient. Constr. Build. Mater. 2013,49, 564–574.
[8] Tseng, K.; Naidu, A. Non-Parametric damage detection and characterization using smart piezoceramic materials. Smart Mater. Struct. 2002, 11, 317–329.
[9] Giurgiutiu, V.; Rogers, C.A. Recent advancements in the electro-mechanical (E/M) impedance method for structural health monitoring and NDE. C.A. Proc. SPIE 1998, 3329, 536–547.
[10] Available at http://www.en.wikipedia.org/



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