DEPARTMENT OF CIVIL ENGINEERING

IIT DELHI

VIRTUAL SMART STRUCTURES AND DYNAMICS LAB

EXPERIMENT 6 (SIMULATION)

Shear Lag Effect (Effect of Bond in Piezo Electro-Mechanical Admittance Signature)

OBJECTIVES

This simulation based experiment is designed to teach the concept of shear lag in piezo based sensing/actuation operating through the medium of a bonding layer. The effect of shear lag on EMI signatures is studied with the aid of analytical models.

OVERVIEW

The phenomenon of difference in the strain induced in the PZT patch from that in the host structure is called as shear lag effect. Figure 1 illustrates the process of actuation of a PZT patch by application of external voltage. As can be seen from the figure, the displacement induced on the surface of the host structure(μ_o) is lesser than that in the PZT patch (μP_o) more about shear lag effect, the user may refer the doctoral thesis of Dr. Sumedha Moharana (http://web.iitd.ac.in/~sbhalla/thesispdf/sumedha.pdf).

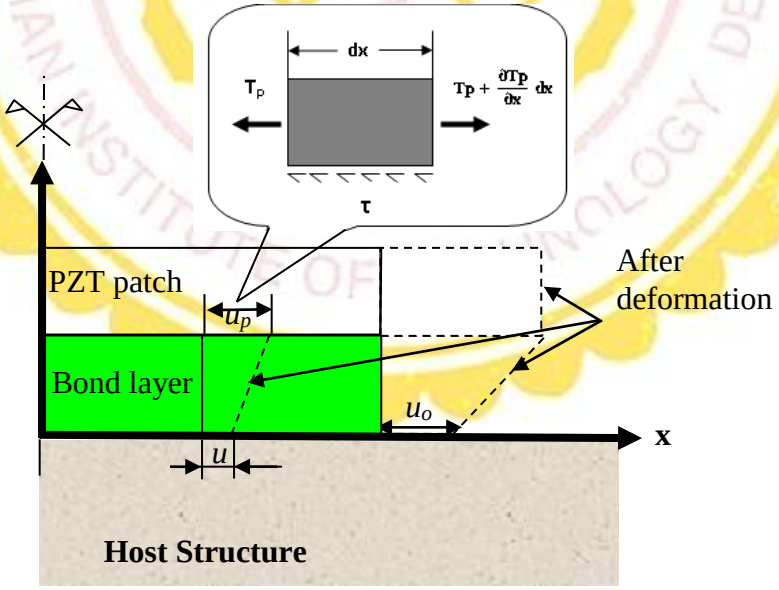

Figure 1: Principle of integrated SHM and energy harvesting

EXPERIMENTAL PROCEDURE

The simulations in this experiment are based on the analytical model developed by Dr. Sumedha Moharana. A host structure considered in this experiment on which the PZT patch is attached using epoxy adhesive as shown in Figure 2. The phenomenon of shear lag can be visualized with the help of animation as illustrated in Figure 2. The user can then derive simulated signatures for various bonding conditions, plot them in excel and visualize the effect of shear lag.

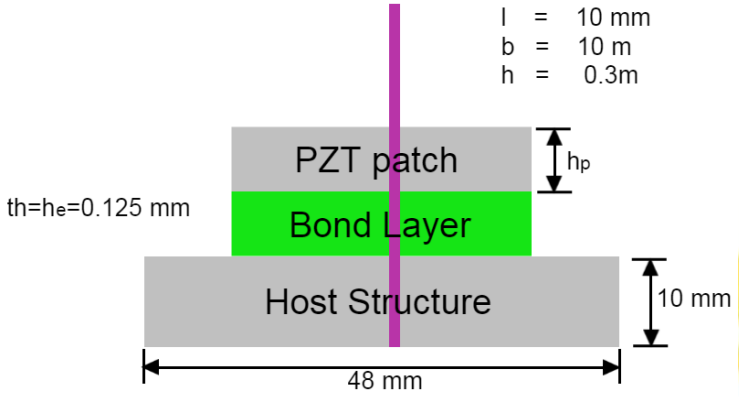

Figure 2: Block diagram of the experimental setup

Figure 3: (a) Setup in compressed form (b) Setup in expanded form.

The deformation of the host structure is slower than the PZT patch and the bond layer.

REFERENCES

1. Moharana, S. and Bhalla, S. (2014), "A Continuum Based Modelling Approach for Adhesively Bonded Piezo-Transducers for EMI Technique" International Journal of Solids and Structures, Vol. 51, No. 6 (Mar), pp. 1299-1310. DOI: 10.1016/j.ijsolstr.2013.12.022 Click here to open --->http://dx.doi.org/10.1016/j.ijsolstr.2013.12.022

2. Bhalla, S., Panigrahi, R. and Gupta, A. (2013), "Damage Assessment of Tensegrity Structures using Piezo-Transducers", Meccanica, Vol. 48, No 6, pp. 1465-1478. DOI : 10.1007/s11012-012-9678-3 Click here to open --->http://dx.doi.org/10.1007/s11012-012-9678-3

3. Link to the thesis of Dr.SumedhaMohrana: http://web.iitd.ac.in/~sbhalla/thesispdf/sumedha.pdf.

4. Literature on piezoelectric sensors: http://ssdl.iitd.ac.in/vssdl/piezo.pdf