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University of Nottingham

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Fig. 1 (Flexible Piezoelectric Device : FPED)

CO2

CO2

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, FPED

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FPED ,

FPED1

FPED FPED

FPED FPED

FPED FPED ,

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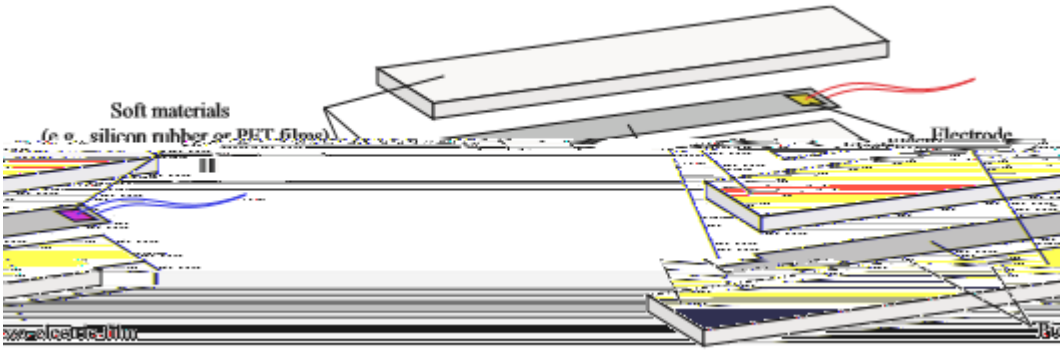

Fig. 1 Basic structure of the FPED

Patel

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. Transfer Matrix

Method i x^{iL} i x^{iR}

W

V 2

4

W θ M Q

$$\begin{pmatrix} W(x^{3R}) \\ \theta(x^{3R}) \\ M(x^{3R}) \\ Q(x^{3R}) \end{pmatrix} = (U^3)(I^{32})(U^2)(I^{21})(U^1) \begin{pmatrix} W(x^{1L}) \\ \theta(x^{1L}) \\ M(x^{1L}) \\ Q(x^{1L}) \end{pmatrix} \quad (1)$$

$$\ddot{\eta}(t) + 2\gamma\omega\dot{\eta}(t) + \omega^2\eta(t) = \ddot{w}_{base}(t)\int_0^L \mu(x)W(x)dx - \varepsilon V(t)[W(x_1+x_2) - W(x_1)] \quad (2)$$

$$C_p \frac{\partial V(t)}{\partial t} + \frac{V(t)}{R_{load}} = -E_p d_{yx} t_{pc} b_p [\frac{\partial W(x)}{\partial x}]_{x_1+x_2}^{x_1} \dot{\eta}(t) \quad (3)$$

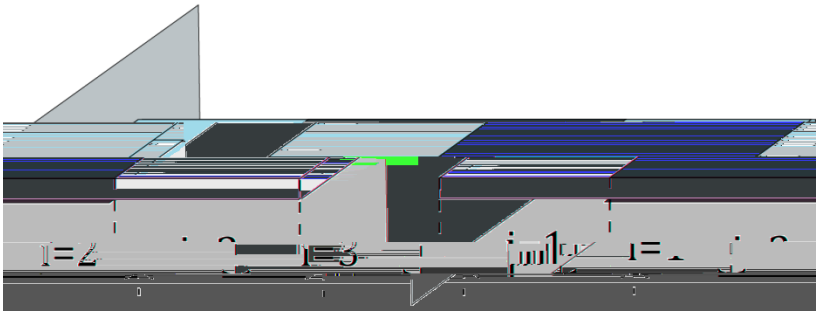

Fig.2 Transfer Matrix Method model of FPED

Fig.3 Fig.4 FPED
FPED Fig.4 K (N/m)

$$W_1(x^{3RK}) = W_1\ (x^{3R}) \quad (4)$$
$$Q_1(x^{3RK}) = Q_1(x^{3R}) \quad (5)$$
$$M_1(x^{3RK}) = M_1\ (x^{3R}) \quad (6)$$
$$Q_1(x^{3RK}) = Q_1(x^{3R}) + K(W_2(x^{3R}) - W_1(x^{3R})) \quad (7)$$
$$W_2(x^{3RK}) = W_2(x^{3R}) \quad (8)$$
$$Q_2(x^{3RK}) = Q_2\ (x^{3R}) \quad (9)$$
$$M_2(x^{3RK}) = M_2\ (x^{3R}) \quad (10)$$
$$Q_2(x^{3RK}) = Q_2(x^{3R}) + K(W_1(x^{3R}) - W_2(x^{3R})) \quad (11)$$

(4)~(11) .

$$\begin{pmatrix} W_1(x^{3RK}) \\ \theta_1(x^{3RK}) \\ M_1(x^{3RK}) \\ Q_1(x^{3RK}) \\ W_2(x^{3RK}) \\ \theta_2(x^{3RK}) \\ M_2(x^{3RK}) \\ Q_2(x^{3RK}) \end{pmatrix} = \begin{pmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ -K & 0 & 0 & 1 & K & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ K & 0 & 0 & 0 & -K & 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} W_1(x^{3R}) \\ \theta_1(x^{3R}) \\ M_1(x^{3R}) \\ Q_1(x^{3R}) \\ W_2(x^{3R}) \\ \theta_2(x^{3R}) \\ M_2(x^{3R}) \\ Q_2(x^{3R}) \end{pmatrix} \quad (12)$$

(12) W (2) (3)
FPED 3

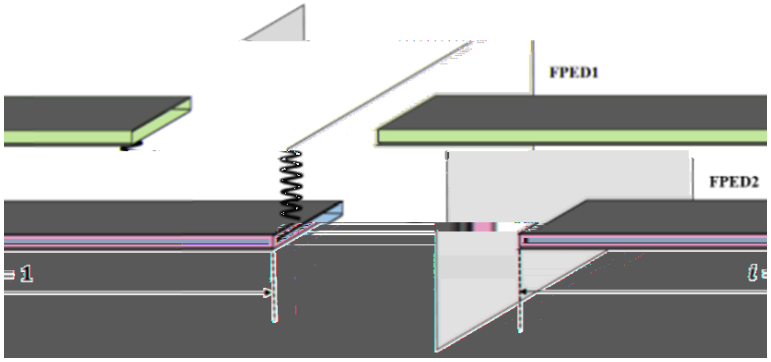

Fig. 3 FPED connected by spring

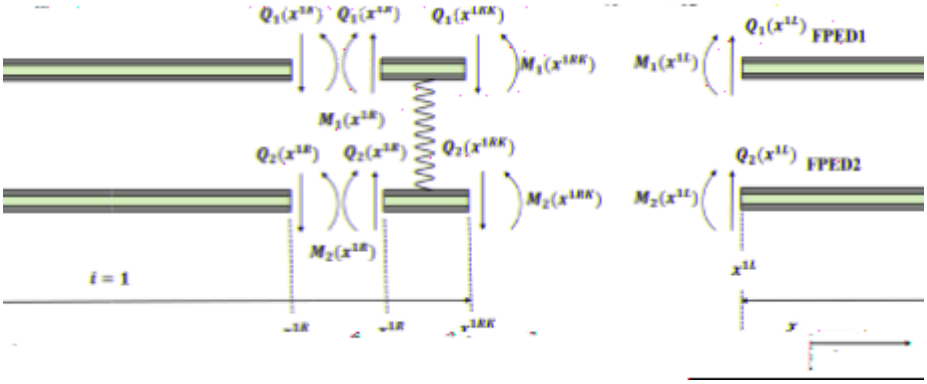

Fig. 4 shear force diagram and bending moment diagram of FPED

Fig.5,Fig.6 FPED

1MΩ 90 (N/m)

490 (N/m) 3 PET

FPED

10m/s^2

10m/s^2 Fig.7

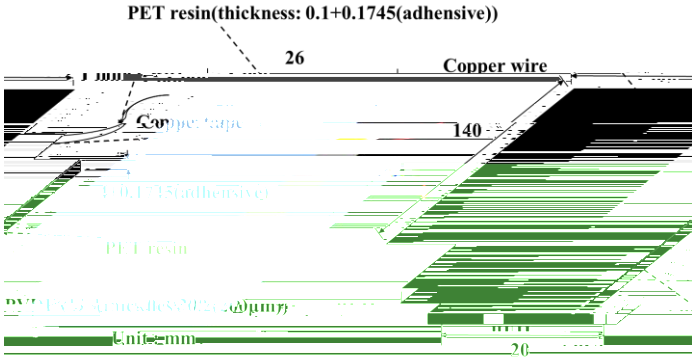

Fig.5 FPED1

Fig.6 FPED2

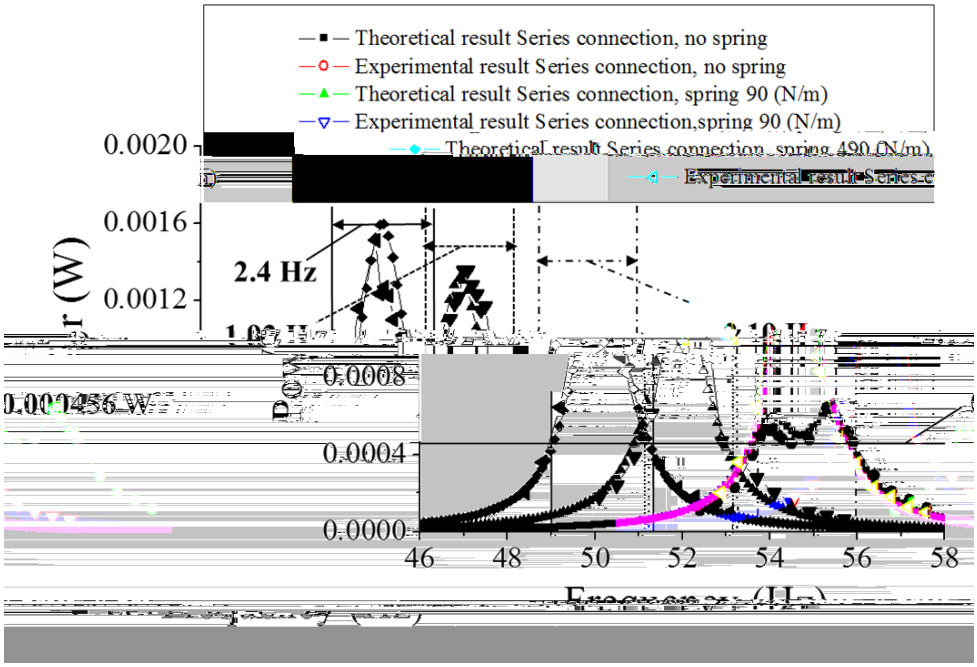

Fig.7 Theoretical result and Experimental result of FPED

FPED FPED FPED FPED

FPED

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Atanas Popov Stewart McWilliam