Experiment:9

DETERMINATION OF SPRING CONSTANT

AIM: To determine spring constant for the material of the given spring and hence to obtain the spring constant in series and parallel combinations by plotting Force – Elongation graph

APPARATUS: Given springs, slotted weights, scale

INTRODUCTION: Elastic materials are those which retain their original dimensions afer the removal of deforming forces. Application of a force on a spring causes elongation. When subjected to stress, strain is produced. Within the elastic limit , the ratio of stress to strain is a constant known as modulus of elasticity.The restoring force is always directed opposite to displacement.Hence the spring performs Simple Harmonic Motion.

Restoring force α – displacement

$$F = -k\,x$$

Here k is the proportionality constant known as spring constant. It is a relative measure of stiffness of the material.

FORMULA:

1. $k = \dfrac{F}{\Delta x}$

2. $k_{parallel} = k_1 + k_2$

3. $k_{series} = \dfrac{k_1 . k_2}{k_1 + k_2}$

Where k is the spring constant of the material of the given spring in Nm^{-1}

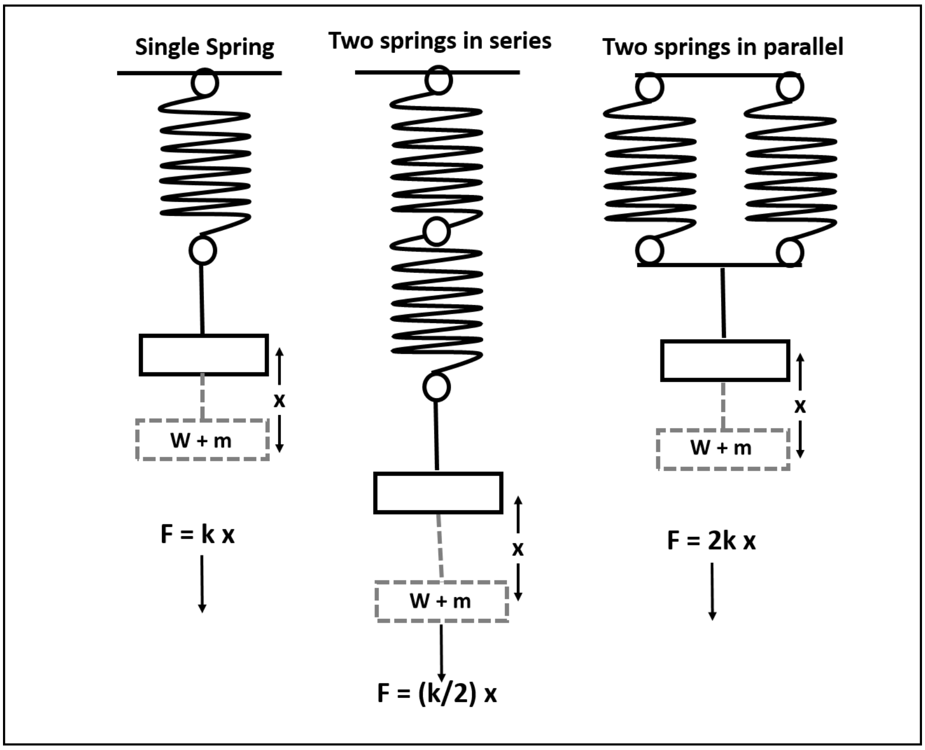
F is the force acting in N

Δx is the elongation produced in the spring in m

k_{series} is the spring constant for series combination of two springs in Nm^{-1}

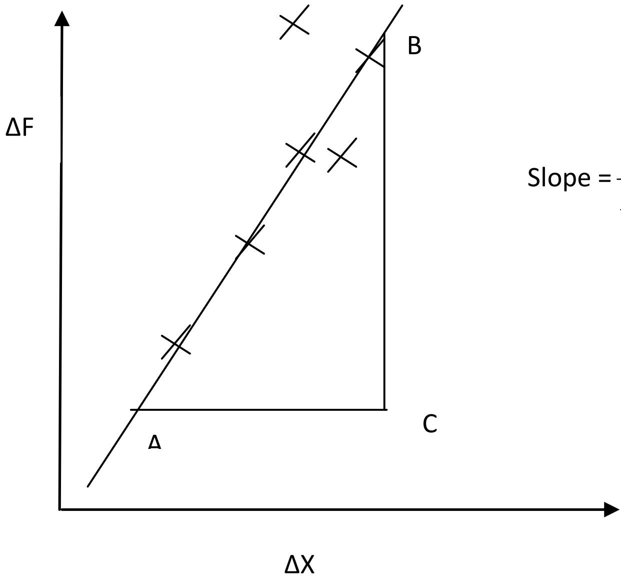
$k_{parallel}$ is the spring constant for parallel combination of two springs in Nm^{-1}

FIGURE:



NATURE OF GRAPH:

Force – Elongation graph



$$\text{Slope} = \frac{BC}{AC} = k$$

TABULAR COLUMN:

Table 1: Single Spring

Tr. no	Weight m (kg)	F = mg (N)	ΔF(N)	Displacement X (cm)	Elongation ΔX(cm)	Spring constant k =ΔF/ΔX (N/m)	Spring constant from graph k (N/m)
1	0.5		-----		------	-----	
2	0.6						
3	0.7						
4	0.8						
5	0.9						

Mean k (from calculation) =……N/m

Table 2: Series combination of springs

Tr. no	Weight m (kg)	F = mg (N)	ΔF(N)	Displacement X (cm)	Elongation ΔX(cm)	Spring constant k =ΔF/ΔX (N/m)	Spring constant from graph (N/m)	$K_{series} = \frac{k_1.k_2}{k_1+k_2} = \frac{k}{2}$
1	0.5		-------		-----	------		
2	0.6							
3	0.7							
4	0.8							
5	0.9							

Mean k (from calculation) =……N/m

Table 3: Parallel combination of springs

Tr. no	Weight m (kg)	F = mg (N)	ΔF (N)	Displacement X (cm)	Elongation ΔX(cm)	Spring constant k =ΔF/ΔX (N/m)	Spring constant from graph (N/m)	$k_{parallel} = k_1 + k_2 = 2k$
1	0.5		------		-----	-------		
2	0.6							
3	0.7							
4	0.8							
5	0.9							

Mean k (from calculation) =……N/m

PROCEDURE:

1.Connect the given spring to a rigid support.

2.Add a slotted loadof W=500 gm at the other end.Note down the displacement for W.

3. Increase the weight in steps of 100g .Note down the displacement for W+100, W+200 till W+400. Calculate the spring constant using the formula.

4. Connect the two springs in series combination and repeat the above activity and calculate k_{series}.

5. Connect the two springs in parallel combination and repeat the above activity and calculate $k_{parallel}$.

6. Plot Force versus displacement graph and find slope.

RESULT:

1. The Spring constant of the given material spring from graph is ………………..N/m and theory is …………N/m
2. The Spring constant of the given material spring from graph for Series combination is ………………..N/m and theory is …………N/m
3. The Spring constant of the given material spring from graph for Parallel Combination is ………………..N/m and theory is …………N/m